Railway Mechanical Engineer

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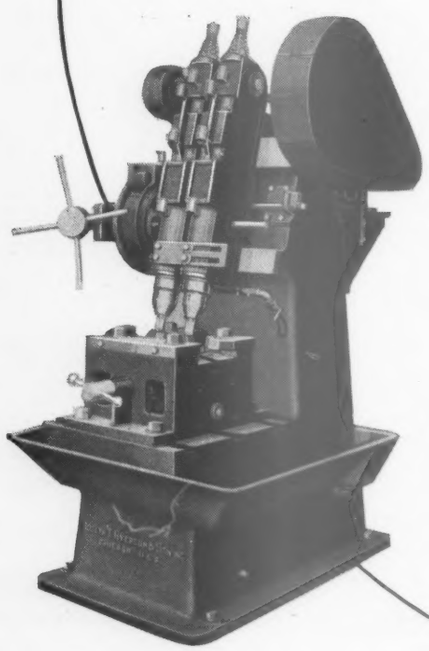

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Railway Mechanical Engineer

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Alloy steels in locomotive parts

The use of alloy steels in locomotive parts has long been under consideration and much progress has been made in their use for frames and forgings. In the case of forgings the possibilities which these alloys offer for the reduction of weight because of the higher working stresses to which theoretically at least, they can be subjected, as compared with carbon steel, have appeared very attractive and, to a limited extent, have actually been utilized. Where doubt has existed as to the possibility of designing these parts for higher working stresses, their use has effected a higher factor of safety, with resulting increases in life and reductions in maintenance cost. A new field for the application of alloy steel is now being opened up; that is, the locomotive boiler. Here a nickel alloy steel has been used for boiler sheets and staybolts, the increased strength of the alloy as compared with carbon steel offering the possibility of providing for materially increased boiler pressures without increase in weight. If the ultimate experience of the limited number of applications of this kind now under way justifies the practice, the limitation as to boiler pressure of the stayed flat sheet type of firebox construction, which is now considered to be approximately 250 lb. per sq. in., will be very materially reduced and the possibility for the rapid extension of higher boiler pressures, without awaiting the development of other types of construction, will be greatly increased.

Grinding lathe and planer tools

An eastern railroad has installed in its toolrooms machines for grinding lathe, planer and shaper tools, the purpose of which is to centralize the grinding and distribution of these tools. The system, briefly, consists of grinding all lathe and planer tools in the toolroom, from which point they are delivered to the machines by messengers who, when furnishing a new tool, take a similar worn tool back to the toolroom. This method is a decided departure from the practice still followed on many railroads of allowing the workman to grind their own tools. The new method has its advantages. An investigation revealed that many thousands of dollars' worth of tool steel was lying idle in the cupboards of the workmen. These tools were removed and placed in the toolroom and the workmen allowed cupboards only large enough to keep their personal tools locked up. As a result of this move, the railroad found that it had on hand enough tool steel to meet its needs for months to come. Every workman had his own ideas as to the correct method of grinding a tool. And as a result there is no standardization of cutting edges for tools which, in many cases, affect production and the quality of the work. The tools, when machine ground, are the most desirable form and the cutting edges are of the proper rake angle. Another reason why this practice is desirable is that it eliminates the non-production time of machines which may be valued at from one to many thousands of dollars while the operators are away grinding their tools. The tool grinder, if used by the operators, is often the common meeting ground where the men are apt to spend unnecessary time in discussions having little to do with production. This source of waste is eliminated by placing the grinder in the tool room to be operated by the tool room attendant.

The mechanical officer's job

It is safe to say that no industry provides its management with a greater diversity of difficult problems relating both to men and materials than does that of railroading. Constantly confronted with questions regarding the choice of materials or processes to give the best results in specific cases, railroad officers practically always find these questions complicated by the ever-present human factor. Doubtless, this explains why the prime requisites for success as a railroad supervisor or officer seem to be long experience, intimate knowledge of details and a judicial turn of mind, enabling all phases of a situation to be balanced, one against another and an intelligent judgment made.

The experience which one large trunk line system had in determining the best method of applying new locomotive valve motion pins and bushings well illustrates the type of problem which constantly faces railroad officers in the mechanical department. This road, in common with many others, at one time used case-hardened pins and case-hardened steel bushings. Trouble developed owing to the pins being galled, and analysis indicated that the causes were improper workmanship, improper case-hardening and lack of lubrication. The method was then tried of using brass bushings and a special grade of steel, untreated, for the pins, which avoided any probability of trouble from a non-uniform job of case-hardening and consequent seizing. It was then found that the non-case-hardened pins were distorted in application by the use of a hard hammer and, as a result, tightening of the nut drew the jaws together causing heating, sticking and seizing of the pin. The lesser of the two evils was therefore chosen and the practice recommended of case-hardening the pins and using hard brass bushings.

Regarding this situation the mechanical engineer of the road said: "Some years ago nothing was ever considered but case-hardened pins and bushings for motion work but the work of fitting them up was considered the most particular and accurate work on the locomotive. All pins were polished after being case-hardened, and all bushings were lapped out with lead mandrels on a drill press, using oil and fine emery. Also, enginemen took

better care of lubricating their locomotives and as a result no trouble of any sort was experienced with motion work pins."

It will be observed from this example that railroad shop practice and, in fact, practically all phases of railroad operation are a compromise of ideal conditions to meet practical considerations. Is it any wonder that experience of long years and judgment of the highest type is required in mechanical department officers and supervisors for the best results?

Greater safety in passenger train operation

The practice that the Pennsylvania has adopted of operating its passenger trains without the use of the angle cock, which will ultimately be eliminated from the brake equipment, is a valuable contribution to advancement in the railroad industry. The idea, however, is not a new one, for the possibility of operating trains satisfactorily without the angle cock as a part of the air brake equipment has been discussed by air brake men at various times during the past 20 years. The tests on which the decision to eliminate the angle cock by permanently clamping the handle in the open position is based, are described elsewhere in this issue. A dummy coupling is used to blank the brake pipe at the end of the train or cut of cars. This permits all switching of cars to be controlled by the air brake. Of course, when switching cars without the use of angle cocks, it is necessary to deplete the brake pipe pressure before any separation is made. Depleting the brake pipe pressure to uncouple the hose makes this operation considerably safer for the trainmen. The Pennsylvania finds that it requires 18 seconds to deplete the brake pipe pressure with the brake valve handle in emergency position in a seven car train equipped with UC valves and 15 seconds to restore the pressure with the brake valve handle placed in full release position. Thus the time required for these two operations is comparatively short, but on the other hand, time is a very important factor at a busy terminal. Of course, the principal reason for eliminating the angle cock is that of obtaining greater safety in passenger train operation. Several serious wrecks have been traced to a closed angle cock somewhere in the train, which deprived the engineman of his full braking power.

Angle cocks have always been a source of trouble, especially in developing leaks at the key. The Air Brake Association Committee on Brake Pipe Leakage placed angle cock keys at the head of the list of worst offenders in its report at the 1926 annual convention. If trains can be operated successfully without having angle cocks included in the air brake equipment, their eventual elimination is fully warranted.

An economic problem in car repairs

The question of manufacturing in railroad shops, to which considerable attention has been given during recent years by various industries supplying material to the railroads, has again been brought to attention by a letter from the American Railway Car Institute to R. H. Aishton, president of the American Railway Association, dealing with the effect on the car building industry of the present tendency of the railroads toward the expansion of manufacturing facilities for the rebuilding of old cars or the building of new cars. This letter (signed by the president of the Institute, J. M. Hansen, chairman of the board of the Standard Steel Car Company, and by two vice-presidents, W. H. Woodin, president, American Car & Foundry Company, and J. F. MacEnulty, vice-president, Pressed Steel Car Company) sets forth somewhat the same reasons as to the unsoundness of this policy, the continuation of which is said to threaten the future existence of the contract car builders, as those set forth in the summer of 1925 by a group of seventeen members of the freight car repair industry in a communication addressed to the Interstate Commerce Commission. These reasons may be divided roughly into two groups: those which deal directly with the immediate welfare of the railroads and those which deal with the broad responsibility of the railroads to the car building industry in particular and for the welfare of the country as a whole. Briefly summarized, the reasons why the continued expansion of manufacturing facilities by the railroads are considered as against the interests of the railroads themselves are as follows: It complicates the problems of organization and management; the qualifications for leadership in railroad organizations have to do with the conduct of transportation and not with manufacture; it involves the assumption of responsibility for a growing number of employees who cannot be employed steadily; peaks and depressions can be more effectively handled in contract shops because contractors are more free from regulatory restrictions; it deprives railroad managers of freedom of action by producing a more irresponsible control of labor; it removes the building of railroad equipment from a competitive field to a non-competitive field, where the incentive for low costs is too remote to be effective; and the costs to the roads of manufacturing and rebuilding equipment in their own shops are normally higher than in well organized contract shops. In connection with the last reason, the letter points out that the car builders are deterred from charging more than a living profit because of the competition in the industry, the effect of which for the past five years has been a net profit below a fair return on the investment in the industry, and that the low overhead commonly figured by the railroads as compared with that of the contract builders, representing as it does a much less efficient development in plant and equipment, would cause failure from inefficiency if the railroads were compelled to make their living from the returns on their manufacturing operations.

The arguments which may be grouped in a second classification are that the car building plants have been built up in response to the railroads' need for equipment and that so long as they remain prepared to serve, the roads are in a measure responsible to them; that the car building plants have rendered invaluable service to the roads and to the nation in important emergencies, notably during the European war when they supplied not only cars, but much military equipment for use abroad; that the highly trained organization of car builders has been responsible for much of the progress made in the design of equipment and in the development of methods for its economic manufacture; that the car manufacturers sustain many other industries, the welfare of which is a matter of importance to the roads and to the country; that it is doubtful whether the roads, being primarily transportation agencies, are more justified in engaging in general manufacturing operations than they are in engaging in the operation of coal, oil and other properties, and that if the roads persist in developing their own manufacturing facilities, much of the half billion dollar investment in contract car plants will be destroyed—an economic waste not justified.

The problem presented is not an easy one to solve. To the car building industry it appears as one of broad

policy which should be considered as a whole. To the railroads it appears as a vast group of individual cases, each one of which is to be settled separately after balancing all of the factors applying in that specific case. The car builders' argument for themselves is really all summed up in the statement that the cost to the roads of manufacturing and rebuilding equipment in their own shops is higher than of having it done in well-organized contract shops. The argument against the railroad is really all summed up in the one statement that the serious impairment or destruction of the investment in the car building industry is economic waste.

This is a matter in the settlement of which mechanical department officers have a large responsibility. The solution of the problem hinges on the question of overhead and it is doubtful whether many mechanical department officers have given this question the serious consideration which it justifies. The neglect to include many items of overhead in the cost of certain manufacturing operations conducted by the railroads is frequently justified on the grounds that they are by-product operations. Such operations cease to be by-products, however, when they require investment in additional plant and facilities not already available. How far this phase of the problem has been overlooked is a matter of fact which can only be determined by a broad investigation. The suggestion that the railroads and the car builders develop a joint board or committee to conduct such an investigation probably offers the best means of establishing the facts. With a comprehensive basis of accepted facts once established, a long step will have been made toward an economically sound solution of the problem.

Are you throwing good money away?

It seems to be a trait of human nature to mount a hobby and then proceed to ride it to death. The contriving and building of devices operated by compressed air, is a hobby that a great many mechanical department foremen persist in riding to the limit. Undoubtedly, the car department is more guilty of this offence, and with more excuse, than the locomotive department. Yet, the latter is not entirely innocent. A surprisingly large number of home-made air-operated tools and facilities, such as hoists, presses, formers and the like, can be found in practically any car repair shop. The most surprising part of this situation is that a large proportion of the jobs done on many of these devices can be done more economically and faster on any one of many manufactured facilities that have been especially designed and thoroughly developed for just such work.

A number of instances can be cited where additional air compressors have been installed in shop power plants to meet the additional load which has been created largely by the increased use of inefficient shop-made, air-operated equipment. An air compressor having an output of 2,000 cu. ft. per min. costs approximately from $16,000 to $20,000. Furthermore, it costs something to operate such a compressor. For example, if it requires 22 b.hp. to deliver 100 cu. ft. of free air per minute at 90-lb. pressure and the engine which operates the compressor requires 30 lb. of steam per horsepower hour, and the boiler evaporates 7 lb. of water per pound of coal, with coal at three dollars a ton, the coal cost per 100 cu. ft. of free air is 0.22 cents. One large car shop uses a home-made air operated press for straightening the sheets for steel cars. The piston for this press operates in a cylinder 30 in. in diameter by 18 in. long. The piston serves as a ram, to the lower end of which is secured a cast iron block, 7 in. by 15 in. by 12 in., which weighs approximately 325 lb. This is operated almost continuously and makes an average of one stroke per minute. At that rate, the press consumes 7.38 cu. ft. of compressed air, or 52.5 cu. ft. of free air per min. at 90 lb. gage, and with the compressor operating at a ratio of 7.12. Using the figure of 0.22 per 100 cu. ft., this press will consume 25,200 cu. ft. of free air per day at a cost of $5.55 for coal alone.

This, keep in mind, does not include maintenance of pipe, hose lines, etc., nor does it make any allowance for leakage. With a pressure of 90 lb. gage, a hole only 1/16 in. in diameter will allow the escape of 380 cu. ft. of free air per hour. A single hole of that size will waste $14.70 worth of coal during a month of 22 working days. It does not require many deficiencies in the equipment, such as having the cylinder too large for the job, a leaky piston the wrong size of piping, etc., to multiply the theoretical cost of operation many times.

Of course, all shop-made air-operated devices are not inefficient, but it would be interesting to know just how many are and how many are not. Such information should be of value to the shop superintendent who is striving for economy in the operation of his shops. The time spent in checking the air consumption of these devices is time well spent. Such information will be of considerably more value if compared with the cost of operating a machine that has been especially designed and constructed for the job. Calculating the air consumption of an air-operated device before it is built, will also, in many instances, result in economy. Some mechanical departments have placed the design and construction of such equipment under the supervision of the mechanical engineer and considerable improvement has been accomplished by this system, not only in the selection of the most efficient of those proposed, but also in the adoption of the best device as standard for all shops on the system. Furthermore, placing the development of shop-made, air-operated devices in the hands of a general supervisor tends to regulate their production and prevents many shop foremen from over-riding an expensive hobby. The air we breathe is free, but don't forget that it costs money to compress it.

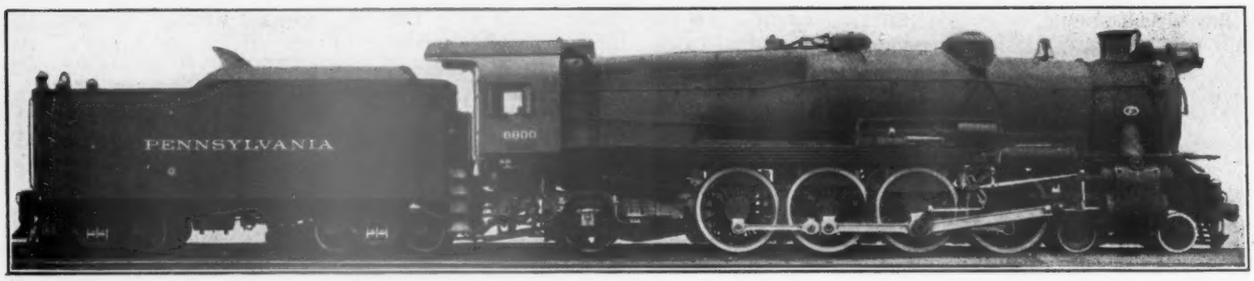
New Books

ARC WELDING, THE NEW AGE IN IRON AND STEEL. *160 pages illustrated. 6 in. by 9 in. Price* $1.50. *Published by the Lincoln Electric Company, Cleveland, Ohio.*

This book is devoted largely to the use of arc welding in general production manufacturing. It stresses the fact that arc welding has developed beyond that of a repairing or salvaging process and that the arc welder is a production tool. It also contends that a knowledge of arc welding principles should be a part of the equipment of every designer and manufacturer working in iron and steel. The book contains more than 200 illustrations, chiefly of products of representative manufacturers which have been manufactured by arc welding. In addition there are numerous diagrams and charts showing welding speeds and costs.

It points out that there are two main fields for production welding. The first and perhaps the best known is the use of arc welding in place of riveting.

The second main field for arc welding is the substitution of arc welded steel for cast iron. This book makes the claim that 90 per cent of the iron castings now used could be replaced by arc welded steel at a decided saving. There is a complete discussion of how to go about redesigning cast iron for manufacture in steel and the illustrations show clearly where this is being done commercially by representative manufacturers.



Mountain type locomotive, Class MI, for the Pennsylvania

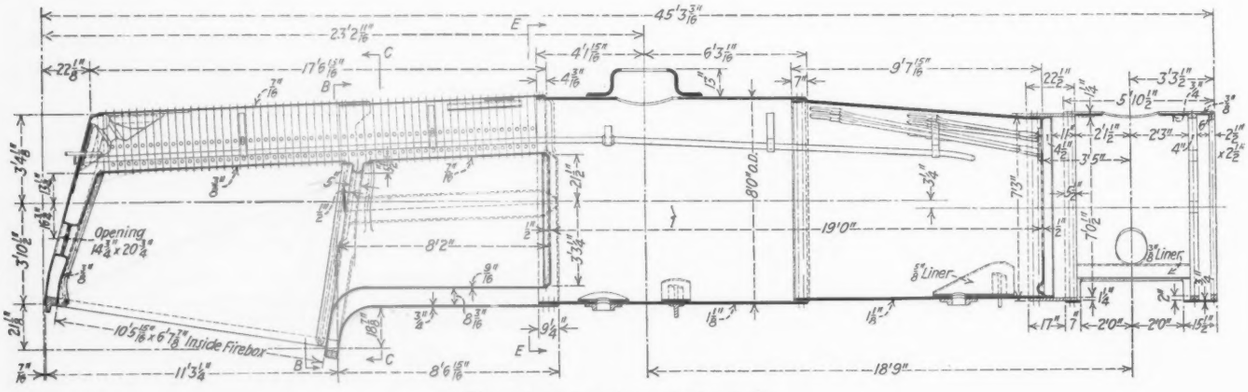
Pennsylvania buys 200 Mountain type locomotives

Several features in design of the boiler and frame—72-in. drivers—Tractive force 64,550 lb.

THE Pennsylvania built at its Juniata shops, Altoona, Pa., in 1923, a 4-8-2 type locomotive which was notable because of its high capacity and unusual construction. In accordance with the Pennsylvania's policy, this locomotive was subjected to a series of exacting tests both on the road and at the Altoona test plant, before any additional units of the same class were ordered. After the locomotive had proved itself fitted for the service requirements, orders were placed with the Baldwin Locomotive Works for 175 and with the Lima Locomotive Works for 25 additional locomotives of the same type. These locomotives are designated by the railroad company as Class M 1, and are now being placed in service. They were designed by the motive power department of the Pennsylvania under the supervision of J. T. Wallis, chief of motive power. They are intended for heavy passenger service, for which reason the driving wheels are 72 in. in diameter, but will also be used for fast freight service.

The Class M 1 locomotive develops a tractive force of 64,550 lb. The cylinders have a diameter of 27 in. and a stroke of 30 in. The boiler has a working pressure of 250 lb. per sq. in. With 266,500 lb. on driving wheels, the factor of adhesion is 4.13. This high starting power in combination with a boiler of generous steaming capacity, enables these locomotives to develop large horsepower for sustained periods.

In accordance with the Pennsylvania's practice, the boiler of the Class M 1 is of the Belpaire type with tubes of moderate length—19 ft. between the tube sheets. Exclusive of the smokebox, the cylindrical section of the boiler consists of two rings, the first of which is sloped, increasing the outside shell diameter from 84½ in. to 96 in. The dome is placed on the second ring. It is of pressed steel and measures 31 in. in diameter and 13 in. in height. The longitudinal seam on this ring is placed on the right-hand side and after the sheet has been rolled to a circular shape it is flanged on top to form the hip joint connection for the Belpaire firebox.

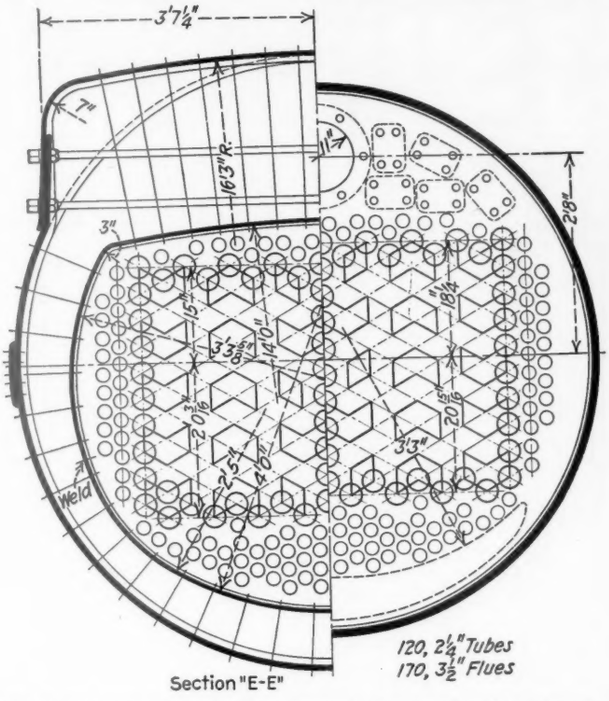


Elevation drawing of the boiler

The combustion chamber in the boiler is 8 ft. 2 in. long and this necessitates the use of a wrapper or outside shell section of corresponding length, having the Belpaire shape and staying. This combustion chamber section of the outside shell is made up of four pieces, namely, a bottom half, which is in one piece with the outside throat sheet; two side pieces and a top piece. The radius of the throat is unusually large being 16 in. at the center, reducing to a small radius at the sides. The outside firebox shell is of three-piece construction, the top and sides being separate.

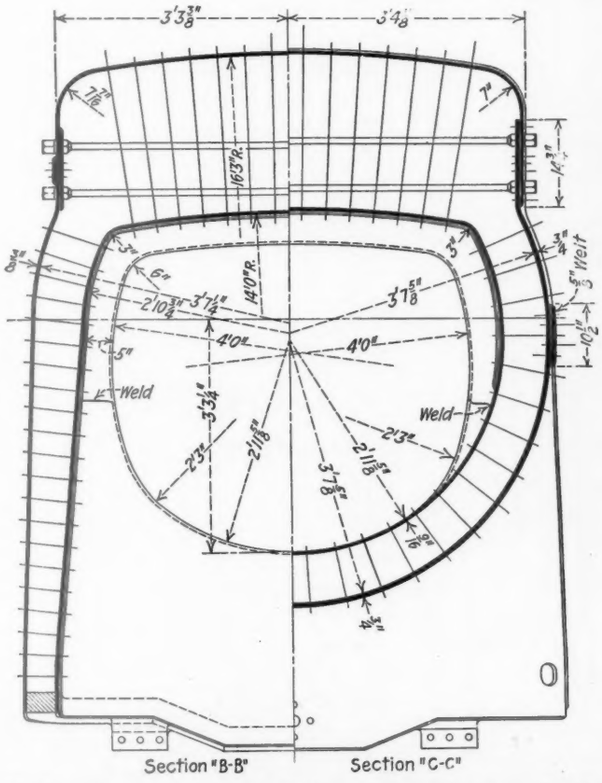
The crown and sides of the firebox are in one piece and the inside throat sheet is in one piece with the lower half of the combustion chamber. The sides and crown

of the combustion chamber constitute a separate sheet, which is butt-welded to the lower sheet on each side. The firebox and combustion chamber are united above the welded longitudinal seam by a corrugated plate



Half sections of the boiler through the combustion chamber and first course

which constitutes an expansion joint. This plate has riveted seams, except on the short longitudinal side seams which are welded. The corrugation is made with



Half sections through the firebox and combustion chamber

a 2-in. radius and forms a trough about 5 in. deep across the crown sheet. This trough can be cleaned through two wash-out holes, one of which is placed on each side.

The flanging of this corrugated sheet is done on a hydraulic press and is an interesting process. As the transverse width of the sheet, after flanging is greater at mid-height than at either the top or bottom, the sides of the die are hinged so that they can be collapsed after flanging and the plate thus lifted out. The flanging of

Firebox and combustion chamber complete, showing the corrugated connection

the throat sheets also requires special treatment, due to the large size of the plates and the fact that the radius at the center is considerably greater than at the sides.

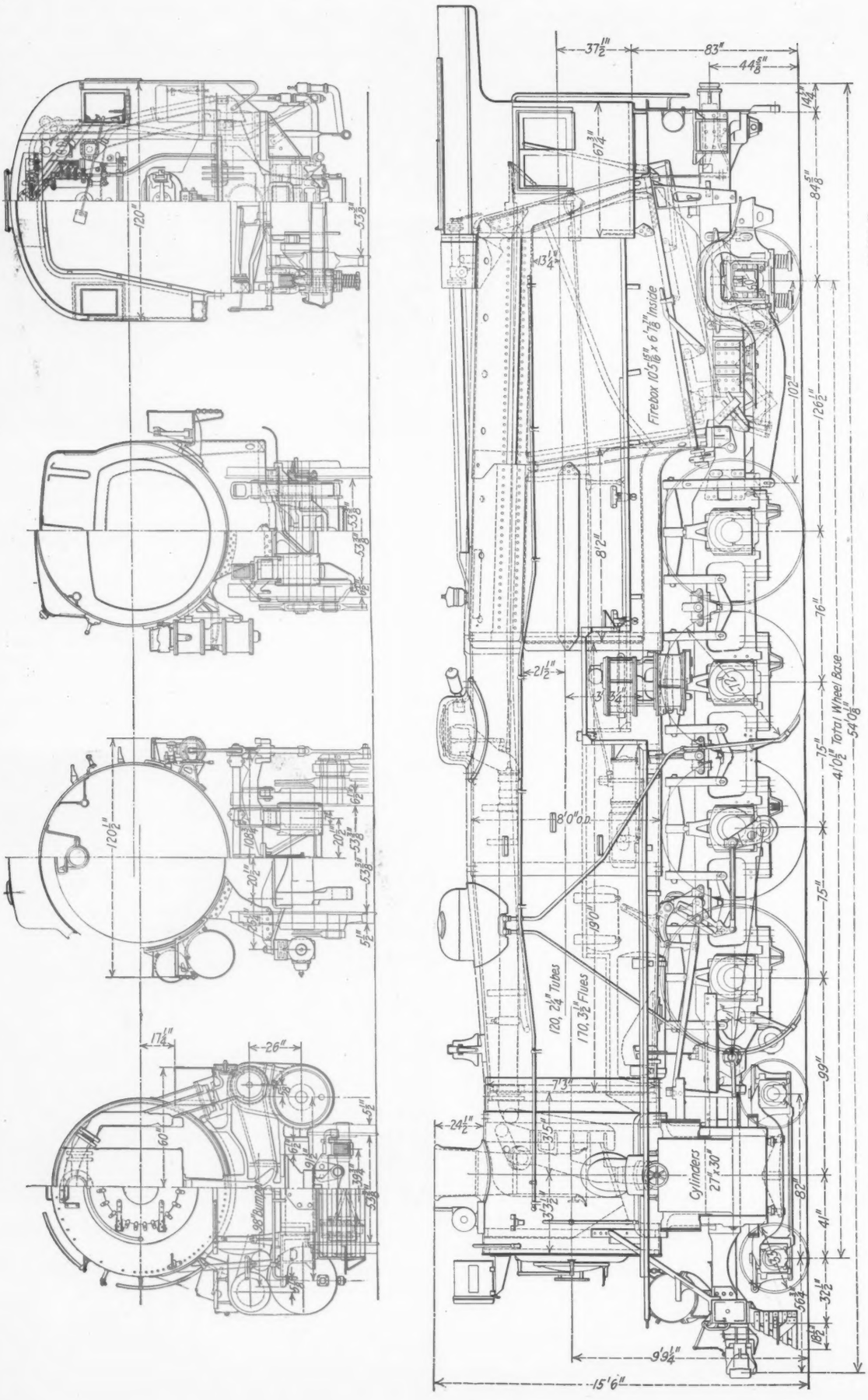
The corrugated joint described in the preceding paragraph compensates for expansion and contraction in the upper part of the firebox. To make similar provision for the lower part of the firebox, a crescent shaped corrugation is formed in the front tube sheet below the tubes. This corrugation has a maxmium depth at the center of 2 in. The combined length of the firebox and combustion chamber is so great in this design that an

Second boiler course flanged for Belpaire connection

arrangement such as has been described is desirable in order to prevent distortion and tube leakage.

The firebox tube sheet and back sheet are riveted in place, but the joint around the door sheet is electrically welded. The flues are welded into the back tube sheet.

These locomotives are fired by mechanical stokers, the Duplex and the duPont Simplex each being used on 100

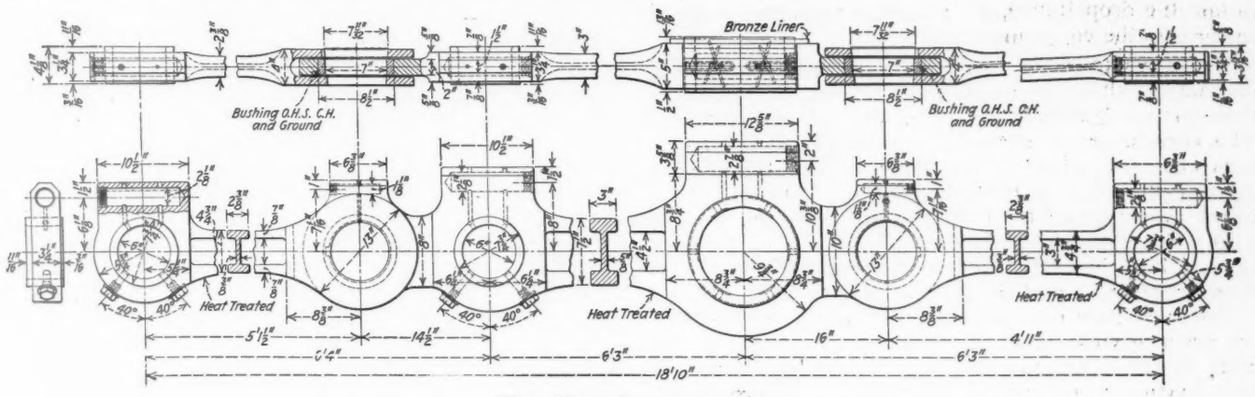


Elevation and cross section drawings of the Pennsylvania, Class M1, Mountain type locomotive

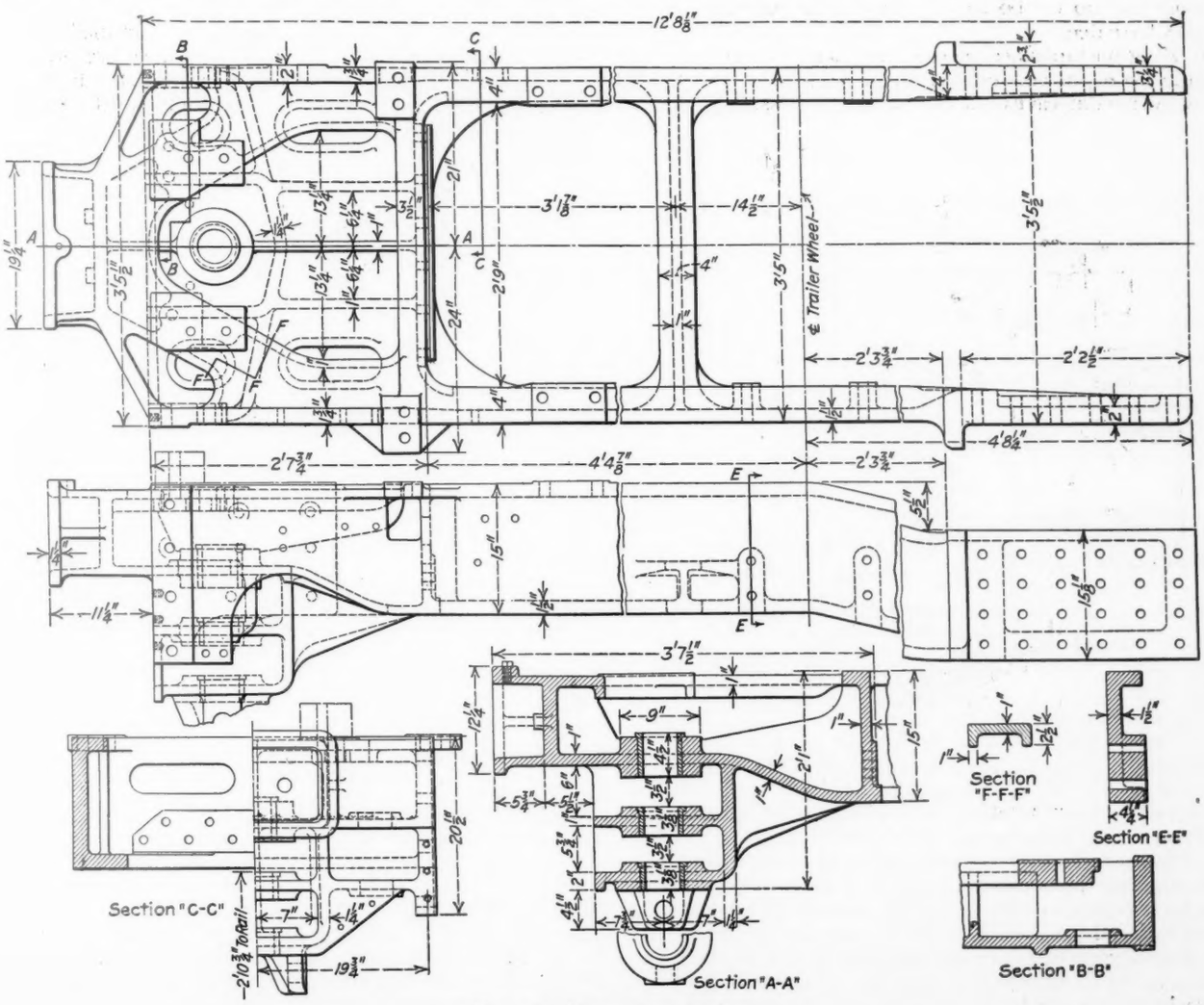
of these locomotives. The grates are arranged to shake by hand and have transverse drop plates near the front end of the firebox. The ash pan has two deep hoppers which are fitted with drop bottoms. These are controlled by levers placed on the left side, under the front end of the firebox.

The two injectors are non-lifting and they feed through checks placed on the back boiler-head. The feed water is conveyed to the front end of the barrel through internal pipes, this arrangement being in accordance with the regular practice of the Pennsylvania. The steam turret is placed outside the cab and receives its steam supply from the highest point in the boiler through an external pipe which connects to the shell near the front end of the combustion chamber roof sheet. The two safety valves are tapped directly into the shell just forward of the steam turret connection.

In addition to the usual gage cocks which are tapped into a water column on the back head of the boiler, there is a second set having pipe connections which terminate



The side rod arrangement



The rear frame construction

over the highest part of the crown sheet. These pipe connections are run through an external pipe which is filled with steam so that condensation is avoided. These gage cocks are placed over the boiler head in the cab. They have extension handles, conveniently located and drain into the drop funnel, so that the discharge can be easily seen by the engineman.

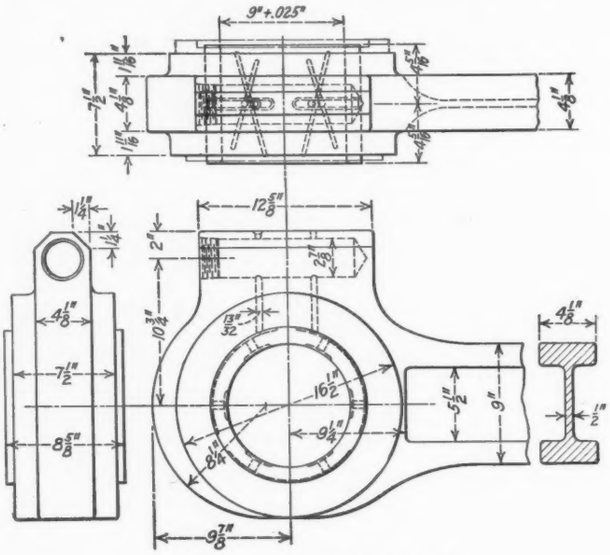
The dome contains a throttle valve with a balancing piston from which steam passes to the superheater header through an internal dry pipe, 8½ in. in diameter. The superheater is a type E composed of 170 single loop elements placed in as many 3½-in. flues. The steam distribution is controlled by 12-in. piston valves which are operated by a Walschaert gear and are set with a travel of 7 in. and a lead of 9/32 in. The steam lap is 1 7/16 in. and the exhaust clearance 7/16 in. A power reverse mechanism is applied.

The machinery details follow the Pennsylvania standard practice which aims at reducing the weight of the parts as far as is consistent with safety by the use of heat treatment and careful designing. The crossheads are of the underhung type, working in box shaped guides which have two inwardly projecting longitudinal ribs on each side in order to provide liberal bearing area. Each guide is made in two pieces, which join on the longitudinal center line and are held together by horizontal bolts. The crosshead bodies are of high test Vanadium steel; while the crosshead pins, piston rods, crank pins and driving axles are of heat treated carbon steel and are hollow bored. The main and side rods are also heat treated.

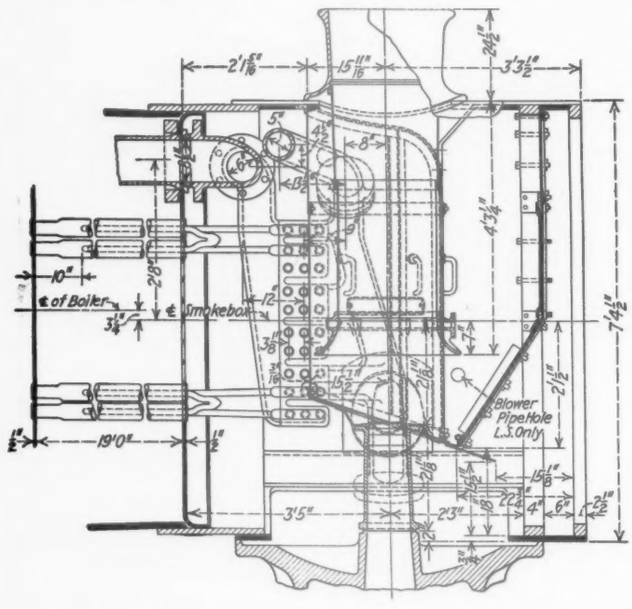
Floating bushings are used on the main rod back ends and the main pin bearings on the side rods. Each stub has a horizontal cavity closed by a compression grease plug and communicating with holes drilled through the brass so that the pin can be lubricated.

The main frames are unusually massive as the width throughout the greater part of their length is 7 in. This is increased above the pedestals to 9½ in. by inwardly projecting lugs. Each frame is cast in one piece with a single front rail having a cylinder fit 6½ in. wide and 12 in. deep. The pedestal caps are of ample section and are held in place by three bolts on each end. Back of the rear driving pedestals the frames assume the form of slabs and are bolted to a Commonwealth cradle casting. The pedestal taper is 1½ in. by 18½ in.

The frames are braced transversely, midway between adjacent driving axles, by steel castings which are bolted to both the upper and lower frame rails. Intermediate boiler supports in the form of expansion plates are provided at the guide yoke which is just ahead of the leading drivers and also between the second and third pairs of drivers. The front end of the firebox is carried on slidings bearings and the rear end on an expansion plate.



Design of main rod back end



Drawing showing the smokebox arrangement

The front truck is of the swing bolster pattern with three-point suspension links, while the rear truck is similar to that used on the Atlantic, Pacific and Mikado type locomotives of the Pennsylvania and formerly known as the KW type. In this design the truck frame itself acts as the rear equalizer and the main locomotive frames are supported directly on it.

In accordance with the railroad company's practice, the driving and rear truck springs are made with a reverse camber when loaded, and flanged tires are used on the front and rear driving wheels only.

Among the interesting details used on these locomotives may be mentioned the bell ringer which is air operated. When the device is in use the bell itself remains stationary, while the clapper moves. The bell can also be run by hand in the usual way if necessary. The cylinder cocks are steam operated and are controlled from the cab. When the operating valve is open the cocks are closed by steam pressure acting on the plungers. When the steam pressure is released, the plungers are moved upward by spring pressure and the cocks open. This provides a ready means of keeping the cylinders drained while the locomotive is standing.

The assembled frames and cross ties

The cylinder cocks will also open in case the pressure in the cylinders exceeds the boiler pressure due to water being tapped in the cylinders.

The tender has a one-piece frame of cast steel and is carried on two four-wheel trucks having cast steel side frames. The fuel and water capacities are respectively 35,000 lb. and 11,000 gal. and an air operated water scoop is applied.

Table of dimensions, weights and proportions for the Pennsylvania Class M1 locomotives

Railroad	Pennsylvania
Builders	Baldwin 175
	Lima 25
Type of locomotive	4-8-2
Service	Heavy passenger and fast freight
Cylinders, diameter and stroke	27 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum travel	7 in.
Outside lap	1 7/16 in.
Exhaust clearance	7/16 in.
Lead in full gear	9/32 in.
Weights in working order:	
On drivers	266,500 lb.
On front truck	59,300 lb.
On trailing truck	56,600 lb.
Total engine	382,400 lb.
Total tender	217,900 lb.
Total engine and tender	600,300 lb.
Wheel bases:	
Driving	18 ft. 10 in.
Rigid	18 ft. 10 in.
Total engine	41 ft. ½ in.
Total engine and tender	79 ft. 3¾ in.
Wheels, diameter outside tires:	
Driving	72 in.
Front truck	33 in.
Trailing truck	50 in.
Journals, diameter and length:	
Main	12 in. by 16 in.
Others	11 in. by 16 in.
Front truck	6½ in. by 12 in.
Trailing truck	6½ in. by 12 in.
Boiler:	
Type	Belpaire
Steam pressure	250 lb.
Fuel	Bituminous
Diameter, minimum inside	82¼ in.
Combustion chamber, length	98 in.
Tubes, number and diameter	120—2¼ in.
Flues, number and diameter	170—3½ in.
Length over tube sheets	19 ft. 1 in.
Grate area	69.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	370 sq. ft.
Arch tubes	29 sq. ft.
Tubes and flues	4,303 sq. ft.
Total evaporative	4,702 sq. ft.
Superheating	1,630 sq. ft.
Comb. evap. and superheating	6,332 sq. ft.
Tender:	
Water capacity	11,000 gal.
Fuel capacity	35,000 lb.
Wheels, diameter	36 in.
Journals, diameter and length	6½ in. by 12 in.
General data, estimated:	
Rated tractive force	64,550 lb.
Cylinder horsepower (Cole)	3,280
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	69.7
Weight on drivers ÷ tractive force	4.13
Total weight engine ÷ cylinder hp.	116.7
Total weight engine ÷ total heating surface	60.5
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp.	1.93
Tractive force ÷ comb. heat. surface	10.25
Tractive force × diam. drivers ÷ comb. heat. surface	735
Cylinder hp. ÷ grate area	46.9
Firebox heating surface, per cent of evap. heat. surface	8.14
Comb. heat. surface ÷ grate area	90.6

Boiled vs. cold saponified greases

By V. I. Downey

Chief chemist, Railway lubrication research department, The National Refining Company

WITH the possible exception of trailer boxes, the lubrication of driving journal and rod pins has been the thorn in the side of every oil company engaged in the lubrication of rolling stock. In the past few years, the arguments as to the merits of the products put out by various companies engaged in furnishing lubricants to railroads have been legion. The sad part of the matter has been that the greater part of the information regarding these products has come from salesmen and service engineers who know nothing regarding the ingredients used in the greases or the process of manufacture.

Up to the first of last year 99 per cent of the locomotive greases were made by the cold saponification method. That is, tallow or a mixture of tallow and stearic acid

were mixed in a kettle with the predetermined amount of cylinder stock. The temperature was adjusted from 90 to 110 deg. F. and a solution of caustic soda run in as rapidly as possible. The whole mass was paddled thoroughly until the first signs of "setting" were observed. The contents of the kettle were then run into barrels. The completion of the reaction between the caustic soda and the tallow took place in the barrel, and after about eight hours the grease was solid. The reaction proceeded for several days longer as evidenced by the heat given off by the grease. Analysis of hundreds of samples from various sources showed that the most satisfactory greases were made over the following approximate formula:

Tallow	44 per cent
Oil	40 per cent
Caustic Soda	7.5 per cent
Water	8.5 per cent

The fact that every grease showed a considerable quantity of free caustic indicated that the saponification was not complete. To secure a more uniform completeness of saponification various companies adopted the practice of aging their greases. That is, a batch of grease had to stand about three months before it could be shipped. The many variables in the manufacture of this type of grease were such as to make a uniform product an impossibility even though aging was resorted to. The temperature of mixing and drawing, acidity of tallow, strength of caustic solution, temperature of storage after drawing and the body of oils used were an insurmountable handicap to the greasemaker in producing grease of uniform quality.

The psychological effect of some of the "educational" work in the railway lubrication game has not helped to make the path of the service man more smooth. In some cases railway engineers have been induced to use two grades of grease, pin grease and cellar grease. Pin grease was a different color from cellar grease and sold for less money, although the only difference was that the cellar grease was darkened by the addition of a small amount of lamp black. The effect of the old custom of two grades of grease is gradually being overcome and many roads are using one kind of grease for both jobs. Some of the oil companies make the light colored pin grease by using a filtered stock in its manufacture, while a dark stock is used in the cellar grease. At least two companies are still putting out the same grease for cellars and pins except that the cellar grease is dyed a dark green. It is to be hoped that one grease can be used for both services or that the various oil companies will make a softer grease for the pins and not sell artificially colored greases of the same composition at a number of different prices.

Hot bearing due to excessive moisture in grease

The failure of so many locomotives in hot weather due to the grease leaving the cellars is inherent in a grease containing any appreciable amount of moisture. A grease can best be visualized as an emulsion. The overheating of the journal causes the moisture to vaporize and boil out. This breaks the emulsion and the oil runs out of the sodium stearate binder leaving a hard cake next to the perforated plate. This cake prevents feeding through to the journal. This hard soap formation is called "carboning" by the average engineman, but as a usual thing no carbon is found. This can readily be proved by dissolving some of the crust in water. A soapy solution is the result.

A very good indication of the performance of a grease when subjected to sudden heating of a journal can be shown by the following test: Draw out a ¼-in. glass tube to a fine point, stick the larger end of the tube into the cake of grease and shove a plug of grease about ⅜ in. long down in the tube to where the capillary begins. Tie the tube to the bulk of a thermometer and place in a large test tube. Place the test tube in an oil bath and heat slowly to around 200 deg. F. If the grease is of the cold saponified type the oil will run down and leave a residue which is the soap. The moisture shows up by being released in puffs which break the cake up into fragments and release the oil more rapidly. This phenomenon takes place in the cellar, as shown by the fact that the residue is usually granular or honeycombed.

Boiled grease

The fact that the above type of grease was unsuitable was recognized by the leading companies and early in 1925, after considerable research, three companies put boiled greases on the market. These greases are made by carrying out the saponification under heat and cooking out the moisture until the finished product contains a small fraction of a per cent of water.

With the old type grease it is necessary to have an excess of caustic soda present in order for the reaction to proceed to the extent it does. This excess caustic soda is a source of irritation to the men handling the grease.

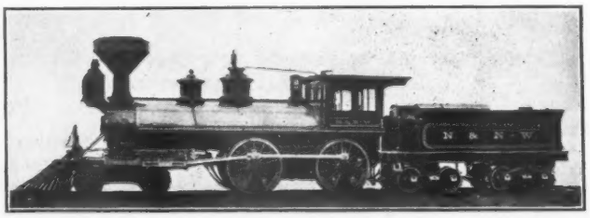
It is possible with a cooked grease to calculate the required amount of caustic necessary to make a neutral grease which will not attack the workman's skin. By carrying the saponification to completion under heat the greasemaker can be sure of getting uniform batches if he uses the same amounts of ingredients each time and the ingredients are kept of the same quality by the purchase of material to specification.

Previous to the advent of the boiled product, a grease was either too soft, too hard or satisfactory, according to the distance which the engineman was able to push his thumb into the cake. With the boiled grease a great deal more oil can be incorporated in the grease with a consequent increase of its lubricating power.

Service tests of boiled greases against cold saponified greases show a greatly increased mileage per pound of grease. This increase in mileage has been shown to be as great as tenfold in many cases.

In the case of slow moving power, switch engines and coal trains, a slight change has been found necessary in the perforated plates. The perforations have to be made larger to insure feeding of the grease since the journal speed is slow and consequently the grease is not heated rapidly enough to cause it to flow through the smaller perforations.

With the advent of so many companies with well equipped laboratories into the railway lubrication field, many radical changes can be expected for the improvement and betterment of locomotive lubrication in the near future.



Northern & North Western locomotive No. 65, built by Brooks in 1881—17-in. by 24-in. cylinders; diameter of drivers, 61½ in.

"The Secret of High Wages"*

The fourth of a series of discussions of books on improved supervision and better employee relations

THE United States is unique among the nations of the world in the high wages paid to its industrial workers and the low prices of manufactured products. As a result workers in this country enjoy a relatively much higher standard of living than anywhere else in the world. Why is this so? Is it solely or even largely because of our great natural resources or are there other important factors involved? These questions are being asked by workers, industrial leaders, statesmen, etc., throughout the world and especially in Europe.

Great Britain in particular has been interested in learning the secret of our success. Two young engineers, Messrs. Austin and Lloyd, visited this country during the latter part of 1925. Their impressions were printed for private circulation; they caused so much comment in the English and Continental press, however, that it was decided to publish a book, "The Secret of High Wages," which is the subject of this review.

It is significant that the Prime Minister of England in an address early this year made the following statement: "I venture to think that no trade union leader could do better service to the cause he represents than by investigating closely what the methods are that enable the American workmen to enjoy a better standard of living than any other working people in the world, to produce more, and at the same time to have so much higher wages." Since that time The Daily Mail of London has sent to this country a mission of eight working trade unionists under the leadership of an industrial adviser, William Mosses, who was for many years general secretary of the United Patternmakers' Association and general secretary of the Federation of Engineering and Shipbuilding Trades, to study our methods and practices. Still another group is now in this country on a similar mission.

It is the purpose to consider here only the report made by Messrs. Austin and Lloyd. Apparently they concentrated their observations largely on what may be termed our more progressive manufacturing plants and commercial organizations—24 in all.

"Prosperity," says the report, "is measured by the ratio of wages to the general level of prices; that is to say, even if wages remain constant, a fall in the price level represents an increase of prosperity." And again, "In America during the last few years the ratio of wages to commodity prices has steadily increased and it is evident that this has been brought about by lowering the costs of production of manufactured articles, lessening costs of transportation of all goods by increased efficiency and by the elimination of waste. *The recent marked increase in prosperity in the United States is, therefore, due more to the last-mentioned causes than to indigenous natural resources.*" (The italics are ours.)

What are the fundamental principles of industrial management to which the authors ascribe our success? Here they are in their own words.

1. The success of an enterprise is, in a large measure, dependent upon a strict adherence to the policy of promotion of staff by merit and ability only.

2. It is more advantageous to increase total profits by reducing prices to the consumer, at the same time maintaining or improving quality, with a consequent increase in the volume of sales, than by attempting to maintain or raise prices.

3. Rapidity of turnover makes for comparatively small requirements of both funded and working capital, i. e., the capital required for shop space (including equipment) and the finance of work in progress.

4. The productive capacity *per capita* of labor can be increased without limit depending upon the progress made in time and trouble-saving appliances.

5. It is better that labor should be rewarded by wages bearing some relation to output, rather than by a fixed wage, the amount of the wages earned by any one man being in no way limited. Contrary to the general belief in Europe, high wages do not necessarily mean a high level of prices. It is to the advantage of the community that the policy of industrial management should be directed towards raising wages and reducing prices.

6. A free exchange of ideas between competing firms should be advocated.

7. Elimination of waste is an essential factor in the attainment of national prosperity.

8. It is important that every possible attention be paid to the welfare of employees.

9. Research and experimental work are of prime importance to progress.

Each one of these principles is amplified in a series of short chapters, the most extensive of which covers Principle 4, relating to the productive capacity per worker. A statement in this chapter is of special significance.

"Since every effort should be devoted to increasing the productive capacity *per capita*, use should be made of the intelligence of every worker and member of the staff by providing the proper incentive. In Great Britain it is unfortunately true that an important asset is lying undeveloped in many industries. This asset is represented by the brains of the workers employed. Each worker's intelligence should be utilized to the full for the benefit of the industry. In many cases in British industry the worker is not encouraged to use his brains and the chief reason for employing him is to make use of his manual skill. The fact that a worker may have considerable intellectual ability is too often ignored."

There is no question, judging from the book and these quotations, that the authors of the report limited their observations of American practice entirely to the more progressive industries and modern commercial organizations.

Many railway mechanical department officers and foremen in this country are coming to a keen recognition of the importance of the human element and the responsibility of doing their share in training and helping each man to develop his peculiar talents to the best advantage. One indication of this is the supervisors' and foremen's clubs and classes for the discussion and study of leadership ability. Another is the revival of interest in up-to-date apprenticeship methods.

The railroads have also been active factors in the campaign for the elimination of waste in which this country has now been engaged for several years. The vast expenditures for improved facilities and equipment and time and labor-saving devices have made it possible greatly to increase the unit output and at the same time decrease the cost per unit—the ton-miles per employee. The railroads also stand in the front rank in

* The Secret of High Wages, by Bertram Austin and W. Francis Lloyd, with a foreword by Walter T. Layton, editor of "The Economist." Published by Dodd, Mead & Co., New York. Bound in cloth, 124 pages, 5 in. by 7½ in. Price $1.25.

the emphasis on conservation of life and limb, as embodied in the safety first movement.

And yet we cannot say these things equally of all railroads or of all railway managements. Some excel in one way, others in another. Few follow a balanced program based on all, or even most of the more fundamental factors of scientific management in its broader aspects. Much still remains to be done, even by the leaders. It is, of course, some considerable satisfaction to view the accomplishments of the past few years, but will we be able to keep pace with the growing demands unless we strive still harder and more intelligently to improve our methods and our leadership ability all along the line—to get the most intelligent work and the most loyal cooperation from each individual in the organization?

But to get back to our book. The last few chapters deal with such matters as distribution, company finance, consumption and saturation point, markets and productivity, and the conclusion. It is a comparatively small book, well written and attractively arranged.

Mr. Layton, in his foreword, makes this statement: "In the bad old days, when factory hours were long, there was in every Lancashire town an individual known as the 'knocker up.' Early every morning—often hours before the dawn—the silence would be broken by his insistent tap on one window pane after another down the empty street. Within a few minutes of his passing would be heard first one step, then another, quickly swelling to a roar of clattering clogs, hurrying along the cobbled road to the neighboring mill. Mr. Austin and Mr. Lloyd are endeavoring to play the part of the 'knockers up' of British industry. Let us hope that they will find that the lady is only sleeping and will respond to their call."

We have not yet got to the point in this country, in spite of the optimistic views of the authors of "The Secret of High Wages," where we can get along without the "knockers up." Their observations are based, not on average conditions, but on those existing in some of our more progressive industries. We need "knockers up" in the other industries and in our railway mechanical departments to bring the average up.

Study of air brake tests at Purdue

MORE than 150 railroad men from all parts of the United States and Canada met at Purdue University, Lafayette, Ind., on November 12, to witness demonstration tests made on the freight train brake equipment submitted by the Automatic Straight Air Brake Company. The investigation under way at Purdue is being conducted by the American Railway Association for the purpose of obtaining more economical operation of trains and of promoting safety for the public and railroad employees. Specifically, the investigation is to determine which brake is the most efficient, economical and safest, for stopping freight trains.

This is the most extensive and thorough investigation which has ever been attempted in the history of power brakes for railway trains. Several new systems of brakes have been designed and constructed and are being subjected to these tests to determine if they are better adapted to railway service conditions than the brakes now in general use. The tests are being conducted in a special laboratory, fitted up by the American Railway Association, which contains the entire air brake equipment for the largest type freight locomotive and 100 cars. The tests have been going on continually for a year and will continue for another year or longer before any conclusions can be reached.

As a result of hearings held by the Interstate Commerce Commission about two years ago in the matter of power brakes and power brake appliances, the tests now being conducted at Purdue University were undertaken under the direction of H. A. Johnson, director of research, A. R. A. The basic schedule of rack tests for freight equipment, which began on November 30, 1925, is as follows:

Series No. 1—Run standard K triple valves through schedule of tests in order to determine the exact functions of present standard brakes for a basis of comparison with the new brake systems which will be tested.

Series No. 2—Install heavier-than-standard graduating springs in all K triple valves and determine the effect of these springs upon the functioning of the K triple valves.

Series No. 3—Run Automatic Straight Air Brake equipment through the schedule of tests.

Series No. 4—Repeat schedule of tests for a train of 100 cars with mixed equipments of standard K triple valves and Automatic Straight Air Brake equipments.

Series No. 5—Run new Westinghouse equipments through the schedule of tests.

Series No. 6—Repeat schedule of tests for a train of 100 cars with mixed equipments of standard K triple valves and new Westinghouse equipments.

Series No. 7—If it is found advisable, after completing the six series of tests given above, repeat tests of Series No. 4 or Series No. 6 with mixed equipments of standard type K triple valves Automatic Straight Air Brake equipments and new Westinghouse equipments.

Series No. 8—Install the three-position 10-20-lb. duplex spring type retaining valves, with which the pressure will blow down from a 10-in. cylinder with 8-in. piston travel, or a volume of 640 cu. in., from 55 lb. to 25 lb. in 85 to 95 sec. when in high pressure position and will blow down from 45 lb. to 15 lb. in 45 to 55 sec. when in the low pressure position, and determine the effect of the blow-down time in the high pressure position on the cylinder pressure obtained with the standard type K triple valve.

The tests made on November 12 were typical of Series No. 3, now in progress, No.'s 1, 2 and 8 having been completed, and were made to give the visiting railroad men an opportunity to inspect the equipment and method of procedure used in conducting the investigation. The equipment now on test was submitted by the Automatic Straight Air Brake Company and was designed to meet the tentative specifications for power brakes issued by the I.C.C.

Informal tests

A schedule of informal tests was made for the general observation of the new equipment with respect to graduated release, maintenance of brake cylinder pressure, the ability to obtain emergency pressure at any time, and uniformity of brake cylinder pressure inde-

pendent of piston travel, which are features claimed for the equipment.

The piston travel of the various cars on the 100-car test rack was adjusted as follows:

Four-inch piston travel on cars No. 2, 3, 10, 15, 23, 28, 30, 33, 36, 38, 39, 40, 45, 49, 50, 55, 57, 68, 70, 80, 81, 82, 92, 94 and 96.

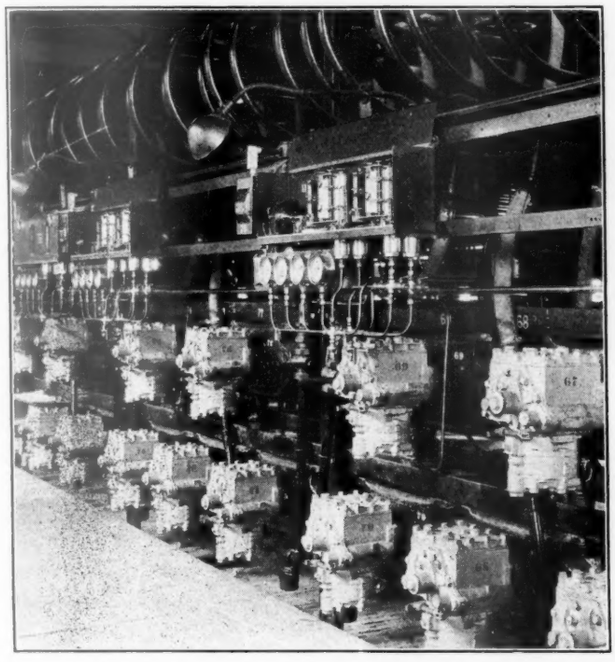
Six-inch piston travel on cars No. 5, 6, 8, 16, 17, 20, 21, 26, 29, 31, 32, 35, 37, 47, 54, 58, 66, 69, 72, 75, 90, 93, 97, 98 and 99.

Eight-inch piston travel on cars No. 1, 4, 11, 13, 19, 22, 27, 34, 42, 51, 56, 60, 62, 64, 65, 71, 73, 74, 76, 77, 83, 88, 89, 91 and 100.

Ten-inch piston travel on cars No. 7, 9, 12, 14, 18, 24, 25, 41, 43, 44, 46, 48, 52, 54, 59, 61, 63, 67, 78, 79, 84, 85, 86, 87 and 95.

Test No. 1, *Charging test.*—With a brake pipe leakage of 7 lb., per min. from 70 lb., a bleed in each brake cylinder which will give a leakage of 5 lb., per minute from 50 lb., with the brake valve in lap position and the pressure in the train brake system depleted, move brake valve handle to release position and manipulate the brake valve so as to maintain a brake pipe pressure of 70 lb. at the brake valve of the locomotive.

Test No. 2, *Service application and holding followed by release.*—With the feed valve set for 70 lb., and the brake system charged, with a brake pipe leakage of 7 lb. per min. from 70 lb., with a bleed in each brake cylinder which will give a leakage of 5 lb., per minute from 50 lb., make a 10 lb. service reduction in brake pipe pressure and lap the brake valve. Five



Automatic straight air brake equipment on the Purdue test rack

minutes after the first brake valve movement, move the brake valve handle to full release position for 10 seconds, then place the brake valve handle in running position for the release of all brakes.

Test No. 3, *Service application, short hold followed by release.*—With the feed valve set for 70 lb., and the brake system charged, with a brake pipe leakage of 7 lb. per min. from 70 lb., a bleed in each brake cylinder which will give a leakage of 5 lb. per minute from 50 lb., make a 10 lb. service reduction in brake pipe pressure and lap the brake valve. Thirty seconds after the brake valve exhaust ceases, place the brake valve handle in full release position for 10 seconds, then place the brake valve handle in running position for the release of all brakes.

Test No. 4, *Service application and holding.*—With the brake system charged at 70 lb., brake pipe and brake cylinder leakage under 2 lb. per minute, make a 5 lb. service reduction in the brake pipe pressure and lap the brake valve for a period of five minutes.

Test No. 5, *Angle cock test.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per min., close the cutout cock under the brake valve. One minute after the last brake has applied, release the brakes by opening the cutout cock under the brake valve, the brake valve handle being left in the running position throughout the test..

Test No. 6, *Straight-away emergency application.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per min., move the brake valve handle to the emergency position and leave it there for two minutes.

Test No. 7, *Emergency following a service application.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per minute, make a 20 lb. service reduction in the brake pipe pressure and lap the brake valve. Two minutes after the first brake valve movement, place the brake valve handle in the emergency position for two minutes.

Test No. 8, *Emergency following release after service application.*—With the brake system charged at 70 lb., the brake pipe and brake cylinder leakage under 2 lb. per min., make a 15 lb. service reduction in brake pipe pressure and lap the brake valve. Two minutes after the first brake valve movement, place the brake valve handle in full release position for 15 seconds and then place the brake valve handle in the emergency position for 2 minutes.

Test No. 9, *Graduated release test; manual compensation for leakage.*—a—With the triple valves set in graduated release position, feed valve set for 70 lb., and brake system charged, with brake pipe leakage of 7 lb. per minute from 70 lb., with a bleed in each brake cylinder which will give a leakage of 5 lb., per minute from 50 lb., make a 15 lb. service reduction in brake pipe pressure at the locomotive, then manipulate brake valve handle between running and lap positions, maintaining the brake pipe pressure at the locomotive at 55 lb. for three minutes after the first brake valve movement to service position in this step.

b—Graduate off the brakes by placing the brake valve handle in the running position until the brake pipe pressure at the locomotive is 60 lb., then manipulate the brake valve handle between running and lap positions, maintaining 60 lb. brake pipe pressure at the locomotive for three minutes from the first brake valve movement to running position in this step.

c—Graduate off the brakes by placing the brake valve handle in the running position until the brake pipe pressure at the locomotive is 65 lb., then manipulate the brake valve between the running and lap positions, mantaining 65 lb. brake pipe pressure at the locomotive for three minutes from the first brake valve movement to running position in this step.

d—Make a service application by reducing the brake pipe pressure at the locomotive to 55 lb., then manipulate brake valve handle between running and lap positions, maintaining the brake pipe pressure at the locomotive at 55 lb. for three minutes from the brake valve movement to service position in this step.

e—Graduate off the brakes by placing the brake valve handle in the running position until the brake pipe pressure at the locomotive is 65 lb., then manipulate the brake valve between running and lap positions, maintaining 65 lb. brake pipe pressure at the locomotive for three minutes from the first brake valve movement to running position in this step.

f—For final release of the brakes place brake valve handle in full release position for 20 sec., and then place brake valve in the running position.

Test No. 10, *Graduated release test without manual compensation for leakage.*—a—With the triple valves set in graduated release position, feed valve set for 70 lb. and brake system charged, with brake pipe leakage of 70 lbs. a minute from 70 lb. with a bleed in each brake cylinder which will give a leakage of 5 lb. a minute from 50 lb., make 15 lb. service reduction in brake pipe pressure at the locomotive, and lap the brake valve for two minutes from the first brake valve movement to service position in this step.

b—Graduate off the brakes by placing brake valve handle in running position until brake pipe pressure at the locomotive is 60 lb., then lap the brake valve for two minutes from the brake valve movement to running position in this step.

c—Graduate off the brakes by placing brake valve handle in running position until brake pipe pressure at the locomotive is 65 lb., then lap the brake valve for two minutes from the brake valve movement to running position in this step.

d—Make a service application by reducing brake pipe pressure at the locomotive to 55 lb., then lap the brake valve for two minutes from the brake valve movement to service position in this step.

e—Graduate off the brakes by placing brake valve handle in running position until brake pipe pressure at the locomotive is 65 lb., then lap the brake valves for two minutes from the brake valve movement to running position in this step.

f—For the final release of the brakes place brake valve handle in full release position for 20 seconds and then place brake valve handle in the running position.

In order to obtain accurate information concerning the functions of all the air brake equipment tested and to be able to compare the data collected on standard type K equipments and the new types submitted a complete

system of analyzing the data from observation and trainagraph records has been installed.

Assisting Mr. Johnson in this work are A. A. Potter, dean of engineering and director of the Purdue University Engineering Experiment Station; G. A. Young, professor of mechanical engineering; W. S. Helmer, representing the A.R.A.; Harry Rubenkoenig, professor of railway engineering, and a large staff of engineers who perform the tests and tabulate and record the data. When the air brake investigation is completed definite statements can be made as to the desirability of new types of brakes as recommended by the I.C.C., the economy of proposed changes and the feasibility of making new installations of newer types of brakes.

Operating passenger trains without angle cocks*

Pennsylvania makes tests in general passenger service to determine practicability

By W. H. Sitterly

General car inspector, Pennsylvania, Buffalo, N. Y.

SEVERAL years ago, the management of the Pennsylvania became satisfied that the angle cock could be eliminated from passenger equipment without detriment to the service, in so far as increasing the time required in switching passenger trains is concerned, and outlined a test at Harrisburg, Pa., where a large percentage of the trains operating through that point are broken up. The test was satisfactory, as it developed that no more time was required to switch a train without the use of angle cocks than with them. Recently the same test was made simultaneously at all passenger terminals on the Pennsylvania Railroad with about the same success as was obtained at the first test at Harrisburg.

The Train Brake and Signal Committee of the American Railway Association, Mechanical Division, became interested and conducted a series of tests at terminals on various railroads in the United States.

Early in August our management decided to eliminate the angle cock by locking the handle in the open position, the brake pipe being closed at the rear of the train by attaching the hose to the dummy coupling provided for that purpose. The date set for this operation to begin was 12:01 A. M., October 1, instructions being given that all angle cocks should be locked in the open position within a period of 72 hr. after that date. All railroads with which passenger equipment cars are interchanged were notified of the effective date of locking angle cocks on all passenger equipment cars. On the Northern division, the New York Central heartily co-operated with us in this operation, both at Exchange Street Station, Buffalo, and at Erie, Pa.

Method of preparing cars

Before going into the supplementary instructions to train service employees in the handling of trains of cars with the angle cocks open, locked in the open position, I might say that the operation was a very simple one. A lock was stamped out of sheet steel. The small orifice is intended to go up over the angle cock handle to keep it from being raised by train service employees. In locking the angle cock handle, it has to be raised before it can be placed in the closed position. The large orifice, after this clamp was placed over the handle of an angle cock, registered with the opening in the angle cock, then the hose, or hose extension nipple used with a type "D" coupler, was applied. This absolutely locks the angle cock in the open position. Presumably instructions will be issued at some time in the near future that when our passenger train equipment goes through the shop for repairs, the angle cocks are to be removed. There will be no loss, because all angle cocks used on passenger cars are bushed from 1¼ in. to 1 in. The only thing necessary is to remove the bushings which will make them available for freight equipment cars. The brake pipe at the end of the train is closed by coupling the dummy coupler into the hose coupling. That is the only interruption from the head end of the train to the rear end.

Supplementary instructions to the Air Brake and Train Air Signal Instruction Book 99-A-1 for attaching and detaching locomotives or cars in passenger train service without the use of brake pipe angle cock, for the guidance of employees who are engaged in the maintenance or operation of locomotives or cars in passenger train service, were issued under date of August 9, 1926, and are as follows:

Instructions for attaching and detaching locomotives or cars in passenger trains

The angle cock handles on all locomotive tenders and cars used in passenger train service will be securely clamped in the Open position, except those on shifting locomotives. The brake pipe stop cocks on the front end of all locomotives will not be modified and may be used as at present.

A—WHEN TRAINS ARE NOT BROKEN UP AND CHANGE OF ROAD LOCOMOTIVE ONLY IS REQUIRED

Arriving train—After stop is made, engineman will make a service brake application of 25 lb., after which he will place the brake valve in emergency position, and leave it there until a signal is received for a release. The air brake hose shall then be parted between locomotive tender and car. The air brake hose coupler on the locomotive tender will then be placed in the dummy coupling, after which a signal should be given to the engineman for a release of the brake. The engine will be cut off in the usual way.

Departing train—After the road engine is coupled to the train, the engineman will make a service brake application of 25 lb., after which he will place the brake valve in emergency position, and leave it there until a signal is received for a release. The inspector will then remove the hose from the dummy coupling on the locomotive tender, and unite it with the hose coupler on the first car in the train, and then signal

*Abstract of a paper presented at the October 14 meeting of the Central Railway Club, Buffalo, N. Y.

the engineman to release the brake, except in cases where a change is to be made in the make-up of the train by a shifting locomotive from the rear. The engineman in charge of the road locomotive must not release the train brakes until the shifting has been completed. The usual air brake tests will then be made after the brake system has been charged to at least 70 lb.

B—WHEN TRAINS ARE BROKEN UP WITH NO CHANGE OF ROAD LOCOMOTIVES

Arriving train—After stop is made, engineman will make a service brake application of 25 lb., after which he will place the brake valve in emergency position, and leave it there until all shifting movements have been completed. The engine and tender brakes may be released, if necessary, by the use of the independent brake valve.

Switching road train—All switching of cars should be controlled by the air brake. The air brake hose on the rear of the rear car (furthermost from the locomotive) in draft shall be coupled to either the dummy coupling on the car or the back up hose. After the shifting engine has coupled to the train and the hose coupler united, the trainman will open the angle or stop cock on the shifting locomotive to release the air brakes on the cars in the train.

When setting off or picking up cars in a train that is being shifted, it will be necessary for the engineman on the shifting locomotive to make a service brake application of 25 lb., after which he will place the brake valve in emergency and leave it there until he receives a signal for a release of the brakes. The trainmen or inspectors will separate the air brake hose couplers where separation is to be made in the train, and couple them to the dummy couplings or standard back-up hose before signaling for a release of the brakes.

When shifting trains without the use of angle cocks, it will be necessary to deplete the brake pipe pressure before any separation can be made, which should be done by making a service application of 25 lb., after which the brake valve should be placed in emergency position until a signal is received to release the brakes. Dummy couplings which are standard for all passenger locomotives and cars, or the standard back-up hose and alarm whistle must be used for closing communication between the brake pipe and atmosphere when making train movements.

The speed of trains while shifting, should be controlled by the air brake, and in no case should shifting or road movements be made unless the brake system is charged to at least 70 lb.

Handling the trains in service

It was my privilege to witness the operation at our passenger car storage yard on the morning of October 1. Our trains arrive and depart from the New York Central station at Buffalo, making it necessary to back them into the station. The movement of the train, so far as the brakes are concerned, is controlled by a pilot on the rear end. Our instructions to enginemen are to lap the brake valve whenever they are approaching a tower or a point where a stop is liable to be made, thereby placing in the hands of the pilot an opportunity to make whatever reduction in the brake pipe he desires without having the air blowing from the main reservoir into the brake pipe as fast as he is trying to draw it down.

On the trains I noticed on that particular morning the pilot came down through the yard and hung the back-up hose on the gate of the Pullman car after which he got up on the platform. He gave six blasts of the communicating signal to the engineman to deplete the brake pipe pressure so that he could couple up the back-up hose.

Immediately after the brake pipe was depleted he stepped down, connected up his back-up hose, and then gave the engineman a signal to release the brakes. After that was done the pilot followed further instructions that he must make a test of the brakes before he leaves the empty car yard, to know that he has control of the brakes from the rear end of the train, and after he was satisfied that the brake system was recharged, he gave the engineman the usual signal to lap his brake valve and applied the brakes by the use of the back-up hose. He then got down on the ground, went over the train as far as the engine to see that all brakes were applied, came back and gave the engineman a signal to release the brakes.

Railway correspondence

The art of letter writing could be studied to good advantage by all railway officers

By J. M. Ganley

Chief clerk, passenger traffic department, Wabash, Detroit, Mich.

MANY thousands of letters, requisitions, reports and other written thoughts are promulgated every day in all departments and branches of a railroad. Very few persons employed on a railroad in these days are exempt from letter writing in some form or other. It is a subject of considerable importance, but, unfortunately, in too many cases it is not given the thought and attention it deserves. This lack of study usually results in the increasing of the amount of correspondence, a large percentage of which could be avoided.

To the average railroad man, letter writing is the hardest task to be performed. In fact, it is considered a useless and obnoxious art by a good many. Why? Because they have never given enough attention to the matter of making the other fellow understand their written thoughts. Some of the most successful foremen and higher officers are the poorest letter writers. It is extremely difficult for the average man to put on paper just what he wishes to say, but a simple remedy for this is to say it the way it would be said if the party for whom it is intended were immediately before us; of course, leaving off certain expletives.

It is not necessary to start a letter with such expressions as, "Your favor of the 13th inst. received, and contents duly noted"; "In reply would state that, etc."; or "We beg to acknowledge receipt of your favor of the 29 ult., and in reply permit us to advise you, etc."; or "In reply to yours of the 27th, I beg to state that," or "For your information." These are old, useless, stereotyped expressions that are outworn and meaningless and only take a lot of time to write.

Take for example the following: "Your favor of the 13th inst. received and contents duly noted. In reply would state, etc." In the first place, why "favor." Is it not a letter of which the writer is writing? Then why not use the right word? "Favor" is affected, indirect and stereotyped. And why "contents duly noted"? Many reams of good letter paper have been filled with that perfectly useless phrase. Of course, the contents were duly

noted. It is a natural supposition that if a man replies to a letter at all, he has given it sufficient attention to know what he is writing about. If the letter has been interesting, or surprising, or has grieved us, or particularly pleased us, we should say so, if we want to, but we should not waste time and space by conveying the useless information that we have read it.

"In reply would state," that is almost as bad as "Contents duly noted." If mention has been made of the receipt of a letter, it is obvious that the letter being written is in reply to the one mentioned, and it is wholly unnecessary to state that fact. Then, again, what is the reason for "would state"? It is simply sufficient to state what is to be stated without telling the reader that this is about to be done. In other words, there are five words that are absolutely unnecessary in the second sentence, and many superfluous ones in the opening sentence.

In regard to the second phrase, "We beg to acknowledge receipt, etc.," why "beg"? Is permission necessary before one may reply to a letter that he has received? The dictionary meaning of the word "beg" is "To ask earnestly for; to entreat or supplicate for; to beseech.' A dog will beg for a bone, but why should a letter writer beg?

In the first place, no doubt, the letter you are acknowledging told you to do so. Then why ask permission for something you already have? It would be much better to simply say, "Your instructions have been received, etc."

"Thanking you in advance." This expression is used frequently, but it is absolutely improper and impolite, as it imples that the person being asked must grant the favor and that you will not take the trouble to thank him after he does grant it.

The importance of punctuation

One subject of importance in every written thought is punctuation. The present-day tendency in business letter writing is to reduce to the minimum the number of punctuation marks used. So far as this brings about the elimination of unnecessary punctuation, the tendency is good, but it is illogical and wrong when carried to the extent that it does away with necessary punctuation. Punctuation is not a matter of personal taste, nor does it depend entirely on good usage. It has two definite purposes to perform; it should make printed or written matter easy to read, and it should help to guard against the writer's meaning being misunderstood by the reader. Good usage determines the kind of punctuation marks that are to be used, but these two purposes determine when they are to be used. Anything that saves time in the transaction of business is worth careful attention. The time saved by the writer who leaves out punctuation marks is so small that it is negligible, but if the reader's time is saved by the insertion of a comma that is necessary to make the meaning clear, it is certainly worth the writer's time to put the comma in.

If the only purposes of punctuation are to make a letter easy to read and to guard against possible misunderstanding, why is it necessary to have any rules on the subject? Why should each writer not be left to decide for himself the places where it is necessary to put punctuation marks in order to make his meaning clear and to facilitate reading? If one were able to see his work as it looks to others, this might be feasible. Whatever one writes, however, is so plain to him that he does not see how it can fail to be plain to everybody else. Therefore, in order to be sure that it will be understood by others, we must apply the rules of punctuation that have been formulated after a careful study of the situations in letters that are most likely to give rise to misunderstandings. These rules are simply the expression of the best usage of conventional practice.

If the rules require a period at the end of every sentence, it is because that is the best way to make the words easily read and to insure the thought being correctly understood. It is true that sometimes in some places the omission of punctuation marks prescribed by the rules would not make the matter particularly hard to read, and would not seriously interfere with the reader's understanding of the intended meaning. No writer, however, is capable of determining this matter for himself. It is best to be always on the safe side, to be absolutely sure that everything possible has been done to make the letter easy to read, and to make impossible any misunderstanding of the writer's meaning.

It may be said, "Well! That is all good enough for a scholar," or that it shows too much "book learning." We are living in an age when we cannot see and talk to everybody we deal with; therefore, we must use some other method of letting him know our thoughts, and if it is necessary that we write, why not write clearly, so that the other fellow will know what we are trying to say?

Letters should be correct and easy to understand

A good many things come under the heading of "correctness." For instance, the size and kind of paper to use and whether or not to write with a pen or pencil. In addressing a superior officer for an increase in wages, or some particular favor, it would not be advisable to scribble a note across some dirty half sheet of yellow paper or on the back of an old envelope. Correctness also means good grammar and correct spelling.

Clearness. If the person who receives a letter is not able to understand what it tries to say, the writing of that letter has been a waste of time. If a letter is worth writing at all, it is worth writing in such a way that its meaning can be understood. If it is not written in that way, there can result only trouble and delay. This also applies to requisitions, time slips—in fact, anything written, for what good is written information if it cannot be read and understood?

When making out a requisition, it is necessary to describe all items accurately and completely. Don't be afraid of being redundant, or saying more than may be absolutely necessary in describing what is wanted. Say too much rather than too little. A good rule to apply here, as well as in writing of every kind, is "Write not only so that you may be understood, but so that you must be understood." We can never go wrong if we keep this objective in mind.

An illustration of the lack of clearness and, in fact, what was actually carelessness, in making out a requisition is given in the following case. A general car foreman ordered some flue reamers. What he wanted was flute reamers. He did not state whether the reamers were to be high speed or carbon steel, and the result was that a letter had to be written asking for the necessary information.

In another case a road foreman of engines made a voluminous report on the condition of a locomotive, but, in his zeal, overlooked the engine number.

There are hundreds of these cases daily and everyone of them means letters and wasted time, whereas a little thought in the first place would save a lot of time and criticism.

Conciseness means brevity, but it also includes completeness. In other words, conciseness means that a letter should be as short as possible, but that it should also say everything that is necessary under the circumstances.

The number of words used is less important than the number of thoughts and the manner in which they are expressed. There are many letters that cannot be both complete and brief, and completeness should never be sacrificed for brevity.

Shortly after the shopmen's strike in 1922, a young man wrote an appealing letter to a superintendent of motive power on a certain railroad, stating that he had served 18 months of his apprenticeship when the strike was called, and asked if he could be allowed to continue and credit be given for his past experience. As men were needed at that time, his request was granted by letter. But the young man never received the letter from the superintendent of motive power as he had failed to give his street address, and the reply was returned unclaimed. We do not know if the young man ever got another chance like that, but no one was to blame but himself. He may have had his address on the envelope, but that envelope, with a hundred others, had found its way to the waste basket and was probably burned before the letter was answered.

Another important point in letter writing is courtesy. A discourteous letter does no good, and if we receive one and answer it in the same strain we only make matters worse. It is always good policy not to write when angry, but *if indignation must be expressed, write the strongest, most discourteous letter you can, and then tear it up.*

A story is told about Secretary Seward who came to President Lincoln with a very severe letter written to a man who had proved himself an out-and-out scoundrel. Mr. Seward hesitated to present it to his chief, but, to his delight and surprise, Mr. Lincoln exclaimed with pleasure, "Only that is not half strong enough. Go back and write it over." Mr. Seward responded with pages that fairly burned. "There," said Mr. Lincoln, "that is just what the rascal deserves." "All right, Mr. President," said Mr. Seward, "I will send it right off." "Oh, no!" said Mr. Lincoln, "don't send it. Throw it in the waste basket."

If you must get angry, do it outside the office or shop. In the first place, you may be wrong in some of your assumptions. The other fellow may be careless, but not criminal, and he may mean well, not ill. Something may have happened so that he could not do what was wanted. Another thing: he may get angry and stubborn and cause more trouble.

Courtesy is a good implement to use when dictating to a stenographer. Stenographers are only human and are not mind readers. Too much should not be left to the stenographer. It is necessary that the dictator do the thinking. It is a good and commendable practice to educate stenographers to do a certain amount of the routine work without assistance, but the important matters should be handled personally. The most annoying and difficult part of a stenographer's job is to take dictation from a person who does not know clearly what he wants to say, or who mumbles and articulates indistinctly.

Another thing, it is not a good practice to trust the work turned out by a stenographer too much. Read your letters after they are written, because it is your signature that goes on the bottom: if anything is wrong with the letter you are the responsible party.

A particularly bad practice is the scribbling of notes or letters for the stenographers to transcribe. In the present day of the typewriter and printed matter, handwriting seems to be a forgotten art; why inflict such punishment on a stenographer and then wonder why the work does not come back to you sooner?

In common courtesy to the other fellow, always mention his file number and the date of his letter that you are answering. This saves considerable time of file clerks and does not allow any chance for misunderstanding.

Only one subject should be included in a letter

Only one general subject should be included in a letter, otherwise there is bound to be a lot of confusion and needless copying of letters so that the various subjects can be properly filed.

A bad railroad practice is the use of initials on telegrams, copies of letters, etc. This may be all right when the paper is not to go out of the immediate office in which it is written, but there is too much chance of the wrong fellow getting the papers, causing delay and extra handling.

Abbreviations should not be used unless they are so clear they cannot be misunderstood. Just what does "R & R" mean? Read and rewrite, remove and repair, remove and replace, or what?

In railroad work, instructions are frequently sent out from the general office, and these instructions are to be passed on to others. In these cases, it is bad practice to quote the letter of your superior officer or post a copy on the bulletin board. It is much better to revamp the letter, over your own signature, and convey the same information.

The too frequent use of that big personal pronoun "I" is obnoxious and often spoils a letter that in other respects is very good.

The "tracer" or "puncher" letter

There is one kind of letter, thousands of which are written daily on the railroads, which should be unknown. I refer to those letters known as "tracers," "punchers" and by numerous other names. We should be ashamed to receive such a letter. Common sense and common politeness should indicate to us that every letter requiring an answer should be answered and answered promptly. If all the information is not available, say so, but do not wait until somebody prods you into action with numerous, and sometimes very sarcastic "tracers." Such a communication means a lot of unnecessary work. First the file clerk has to get the letter out of the file and take it to the desk that wrote the original letter. Then the stenographer has to write a tracer, which goes to the other person who has to look for his file, match up the papers, find out what has been done and then reply. Practically all of this could have been avoided if he had taken time enough to have answered the letter at the proper time.

The biggest trouble with the average letter is that the recipient does not read the letter carefully and thoroughly and, in most cases, does not grasp what the letter has said, which means more correspondence and a useless waste of time and money. Every letter that is important enough to be written is important enough to be read carefully and, if at all complicated, it should be studied. Many railroad letters are skimmed through daily and only one or two of the main points absorbed by the reader who makes a vague reply and only partly covers the subject.

Letters of commendation and censure

There is a type of letter that is very little known in railroad circles, although there is no doubt as to its value, if properly used. This form of letter takes more time and pains than the ordinary letter of instruction or criticism, but the result is generally worth the effort. The writer refers to letters of inspiration or commendation for some good performance, or to coax along a weak brother who only needs a little coaching and encouragement to make him "hit the ball." Assume for a minute

that you are a car foreman at some outlying point with only a handful of men working with you where you were "sweating blood" every hour of the day to keep things moving and you received a letter like this from your boss:

What is the matter with the bad orders at your station? You certainly are not getting results and, if some decided improvement is not made in a short time, drastic action will have to be taken.

You would probably wire the boss to send another man on the first train, but, on the other hand, you might have certain obligations of more importance to you than your personal feelings and would not be able to take such action. Would not a peppy, inspirational letter like the following be more successful and would it not make you feel like digging in harder?

The first of the month will be just 15 days away when you receive this letter—just 15 days for you to make the best showing on bad orders and hot boxes this year. We are doing it at all other points on the division, and I know that you can do the same. So far this month, you have not done so well, but I know you will dig in and help us make the best record ever made on this division. Watch the packing of boxes closely.

You have the ability, Tom, and I know you will not fall down on us.

Consider the enginehouse foreman after he has had a visit from a federal inspector, who has tied up several of his locomotives. It would not pay to increase the load on his already overburdened shoulders. If he is any kind of a foreman at all, he keenly regrets the results of the inspection. Most likely the transportation department is hounding him for the locomotives. Maybe a few of his best men are off sick, the air compressor is not working properly, or something else is wrong. He needs encouragement now, more than at any other time. A sassy, impudent letter reflecting on his ability would certainly do no good. Would he not feel much pepped up and ready to dig in again if he got a friendly letter from the boss, something like the following:

It is too bad that the government inspector had to tie up the 1302 and the 993. No doubt, you had a hard time to recover from the mess.

I notice that you got clear records on six locomotives. That is very good and shows that you and your inspectors are alive to the situation and on the job. Keep up the good work, and particularly impress on the men the necessity for remedying the small defects.

So far this month, we have done very well on this division and your six OK's helped to boost the average.

While we dislike to get the red cards, I think I appreciate your feelings and I feel sure that the next time one of the inspectors shows up he will find nothing to report.

I expect to be in on No. 7 Thursday and will talk over the situation with you.

The hardened railroader will probably laugh at this kind of letter, but is it not better than the ugly, sarcastic kind which only tends to make the receiver ugly and stubborn? Of course, it would not be advisable in all cases to use this type of letter as there are still a good many old-time foremen who must be driven and toward whom the "come along" attitude is useless.

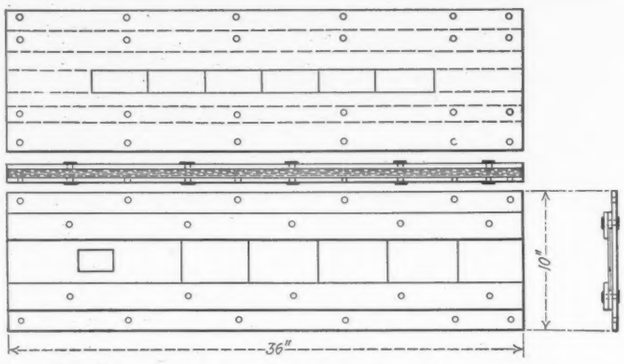
Keeping cold air out of the cab

By J. E. Allen

THE device, shown in the drawings, for keeping cold air from blowing up through the slot in the cab floor around the reverse lever will be appreciated by many enginemen. It has been used successfully on one road for some time and a number of favorable comments have been received, especially during last winter.

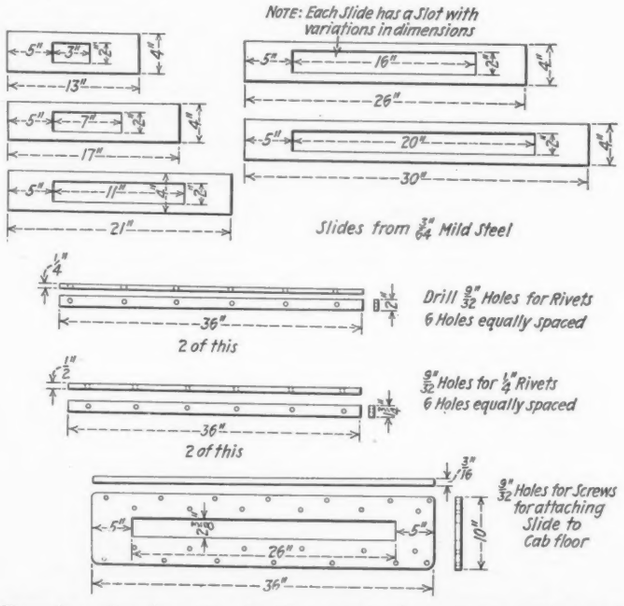
The device consists of a base plate of 3/16-in. boiler plate, provided with a ways in which slide a number of plates, laid one on top of the other. The base plate, 10 in. by 36 in., a detail of which is shown in one of the drawings, has a slot 2⅜ in. by 26 in. cut lengthwise in the center which allows free movement of the lever. The ways for the slides are also made of boiler plates, the flange piece being ¼ in. thick by 2 in. wide and the filler piece ½ in. thick by 1¾ in. wide, allowing a ¼-in. flange over the slides.

The slides, shown in one of the drawings, are 4 in. wide and are made of 3/64-in. steel. Each slide has a slot



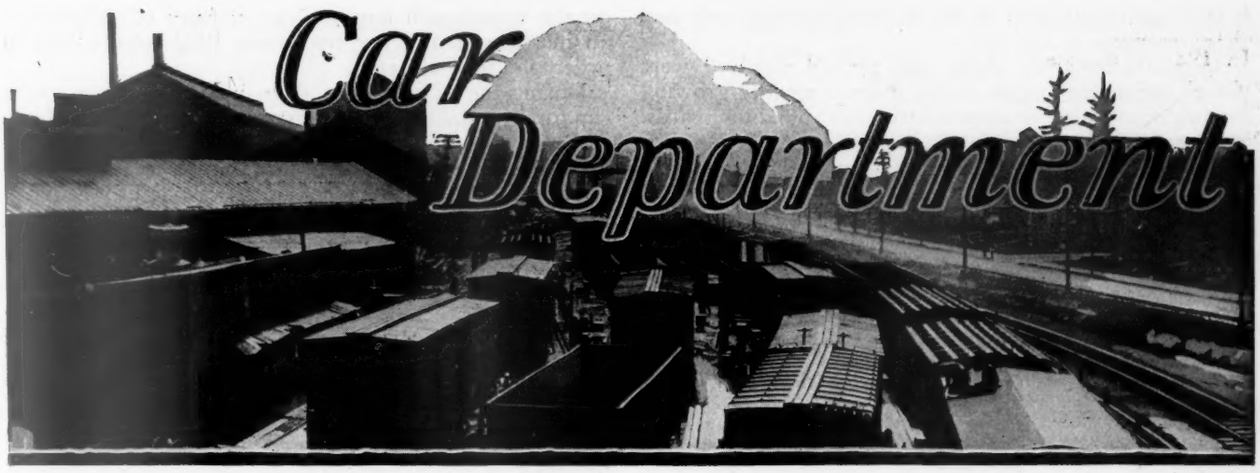
A collapsible reverse lever slide for keeping cold air out of the cab during the winter

2 in. wide cut out along the center. When assembled on the locomotive, the reverse lever extends up through the slots in the slides which are placed in the ways of the base plate. The bottom slide is 30 in. long and has a 20-in. slot cut in the center. The 26-in. slide is placed on top of the 30-in. and thus in order of length with the 13-in. slide on top. The slot in the top slide fits snugly around the reverse lever and as the reverse lever is moved either for-


Note: Each Slide has a Slot with variations in dimensions
5" 3" 2½ 4" 13"
5" 16" 2½ 4" 26"
5" 7" 2½ 4" 17"
5" 20" 2½ 4" 30"
5" 11" 2½ 4" 21"
Slides from 3/64" Mild Steel
1/4" 36" 2 of this
Drill 9/32" Holes for Rivets 6 Holes equally Spaced
1/2" 36" 2 of this
9/32" Holes for 1/4" Rivets 6 Holes equally Spaced
3/16" 5" 2½ 2½ 5" 26" 36" 10"
9/32" Holes for Screws for attaching Slide to Cab floor

Drawing showing the detail construction of the slides and base plate

ward or backward, it successively comes in contact with the ends of the slots in the lower slides, which then are carried along with the reverse lever. Each slide, however, covers the slotted opening in the slide underneath. Thus, regardless of the position of the reverse lever, cold air is prevented from coming up through the floor of the cab.



Rebuilding coal cars at Yale car shops of the Frisco*

An average daily output of ten 40-ton gondolas is obtained with a working force of 225 men

YALE, Tenn., lying just out of Memphis, was chosen in 1912 as the logical place for the repair of Frisco cars. Light repair tracks and light equipment were installed and until 1918, a small force of men was maintained at Yale to handle the light repairs to all classes of equipment that found its way to the Southern division and needed attention.

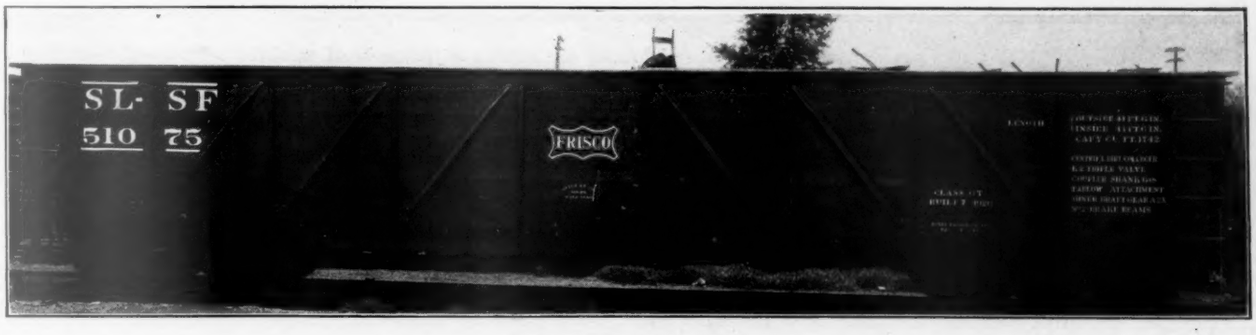
Two workmen ream 1,000 holes in 30 minutes

In 1918, the favorable location of Yale to the Southern division and its close proximity to the rapidly growing coal fields of Alabama, combined to bring it up from the light repair class to a heavy repair plant, and the capacity of the yards was increased.

The car frame is laid on the ground in which position the air cylinders and all draft attachments are applied

It was, in addition, freed from the work of repairing all classes of equipment, and designated as the only

*An abstract of an article which appeared in the September, 1926, issue of the Frisco Employees' Magazine.



The finished product

hopper car repair shop on the Frisco, receiving only coal cars for repair.

In 1921, the Yale yards had proved out and were moved up another notch in the Frisco's rapidly growing organization, and designated as car building yards. During 1921 and 1922 the Yale yard force of workmen built 80,000 lb. capacity, all wood coal cars at an average of 50 a month, turning out 1,200 of these cars in the 24-month period. During the months from July, 1922, to January, 1923, inclusive, the yards were shut down, owing to the strike, but on January 1, 1923, the Yale plant opened again.

This time work began on a still larger scale, and 130

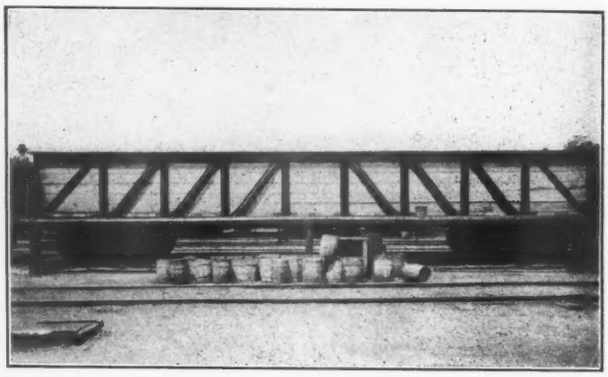
A general view of the Frisco car repair yards at Yale, Tenn.

men again began turning out the 80,000-lb. capacity gondolas at the rate of 50 a month. The coal tonnage of the Frisco was growing by leaps and bounds at this time, and more and more cars were needed to haul the coal from the Alabama fields. During 1923, another 1,200 of the 80,000-lb. capacity, all-wood gondolas were turned out, and in 1924, the yards expanded further and increased the monthly average from 50 to 65 cars.

There was a heavy demand for equipment in 1925, and the first four months of that year found the yards at full capacity. Four hundred of the government type coal cars were turned out during January, February, March and April—an average of 100 a month. The rest of the year the average of 50 a month was carried on.

For the first four months of 1926, the Yale plant was marking time waiting for material for new cars. But on the seventeenth day of May, a force of 225 men—an increase of 125 per cent since 1922—started on an order of 950 coal cars.

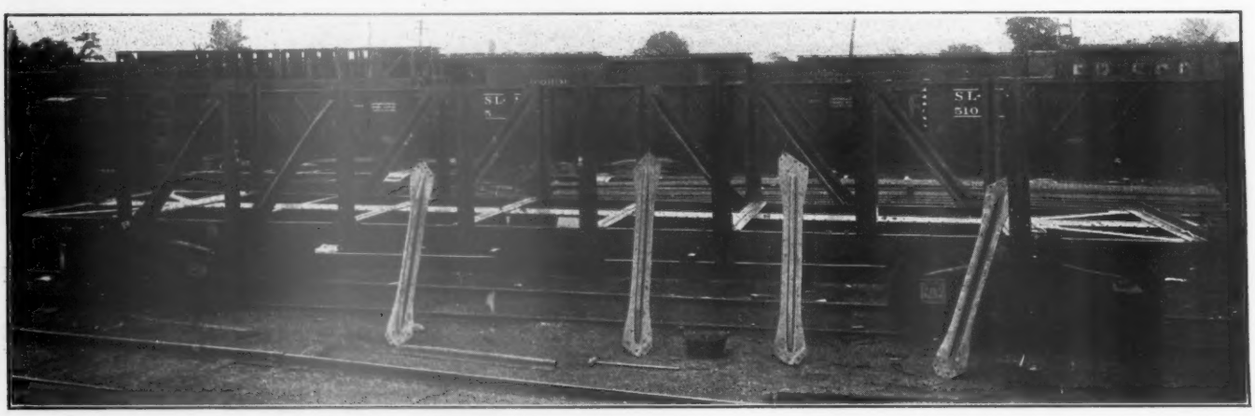
During the 12 remaining days in May, the men under car foreman Jake C. Lutz, turned out 50 cars. In June, 228 cars were built with the same 225 men—a car and a fraction to each man. In July they averaged ten cars a day, and the average for August was slightly better.



Six men place twelve 2½-in. by 9¼-in. by 42 ft. fir side boards on a car in approximately 35 minutes

The Frisco is both spending and saving money in the Yale yards. The expense now approximates $450,000 a month at Yale and the force is turning out an average of 250 cars a month. Each car is valued at $1,800.

The most rigid economy is maintained in building the new cars and the saving is shown monthly in the saving per car. The trucks for the new cars come to the Yale yards from all over the Frisco system. The truck bolsters are changed, two new cast steel truck side frames are put on each car, a new spring channel and new truck springs are installed all around, and new brasses, journal wedges, dust guards, box packing, brake beams and brake beam hangers, hanger pins and brake connections, put in. This is done to each set of trucks before they are considered fit for the new equipment.



At this position all the stakes and braces are riveted in place in 45 minutes

Method of rebuilding the cars

The trucks leave the truck shop for the first position in the car shop and are put on the building track. The body is lifted on the trucks by a Brown hoist. The fit-up men place all stakes and braces in 30 min. after which the car is moved to the next position where 1,000 holes

are reamed in about 30 min. Then comes the driving position where a crew of 16 hammermen, buckers and heaters, rivet the 1,000 holes in about 45 min. Then the car is floorboarded with another crew of six men in about 35 min. and after one more operation in which safety appliances are put in place, the car is cleaned for the painter. Three coats of paint are applied, the first a coat of Brown primer, and two coats of carbon black. Three days are consumed in this operation after which the car is stenciled.

There is a friendly rivalry among the men on the

Fifteen men are engaged in dismantling and in rebuilding trucks which are sent to this point from all over the system

building tracks that is the very essence of good workmanship. It is a tradition on the building tracks that the Brown hoist must not wait long for a car to be finished in one position, until it is moved to the other. If the hoist approaches the driving position, the men will speed up their hammers and redouble their efforts. As a result the engineer of the hoist will see in record time his hook attached to the car for the short trip to the next group waiting to put it through the next process.

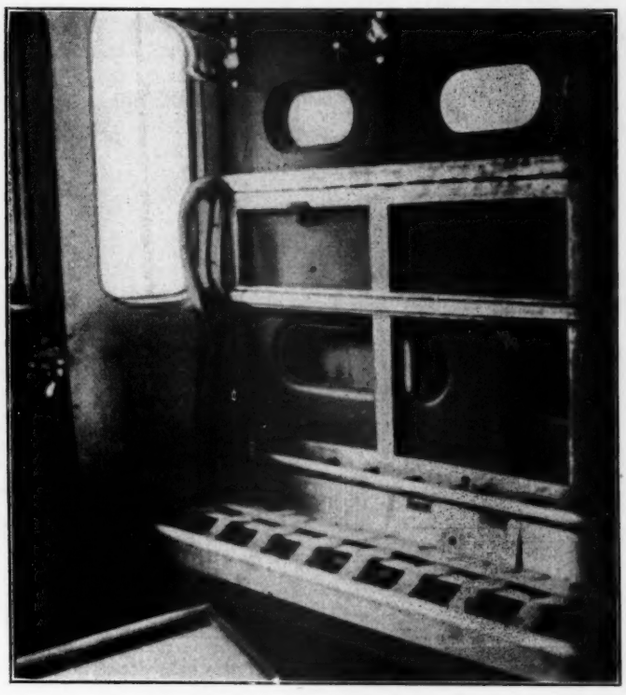
All-metal passenger cars built in France

By A. Eisenschmidt

Chemin Ste Barbe, Gaillon, Ense, France

A PASSENGER car of all-metal construction was exhibited by the Compagnie des Chemins de Fer du Nord Francais at the Exposition des Arts Decoratifs which was held at Paris last year. The body of this car is 64 ft. long, with a length over the buffers of about 66 ft. The distance between truck centers is 44.42 ft. The object of the designer was to construct the body of the car so as to have the same stresses as would be set up in a hollow beam under the same load and reactions. The underframe consists of two side sills tied together at the center by a single cross-piece riveted to a cast steel block which in turn riveted to the side sill. The trucks are pivoted on pressed steel plates, a top view of one of which is shown in an illustration, riveted directly to the side sills in lieu of the usual form of body bolster. The underframe has also additional bracing of steel plates stamped to the desired shape.

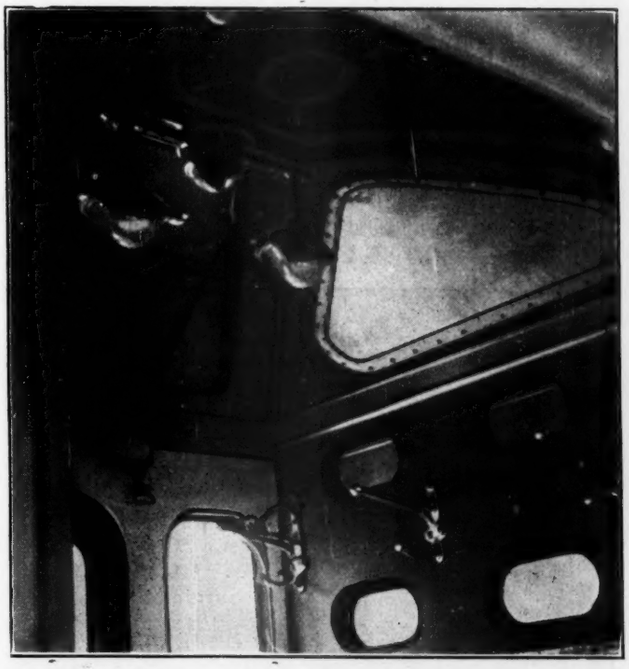
The body of the car, shown in one of the illustrations, is constructed entirely of steel plate, the various parts of which have been pressed to shape. The side and end pieces are of 5/32-in. steel plate, cut and stamped to shape, including the openings for the doors and windows. The length of each side sheet corresponds to the width of a single compartment, each single sheet having openings for one door and two windows. The side sheets are riveted and soldered together. The ends are stamped and



Interior view of one of the compartments, showing the construction of the seats and division walls

cut, as shown in one of the illustrations, with one vertical and two diagonal braces.

Between the compartments are partitions each made of



Interior view of one of the compartments, showing the construction of the roof and top part of the division walls

two steel plates about ⅛ in. in thickness. These plates are placed side by side, making a partition, including an

air space, about 1 9/16 in. in thickness. A door is provided in each partition to allow room for a passageway along one side of the car, the door openings in the two partition sheets being stamped out. The two plates in each partition are secured together by means of rivets and soldering to reduce any vibration and are designed to

View showing the end and part of the side construction

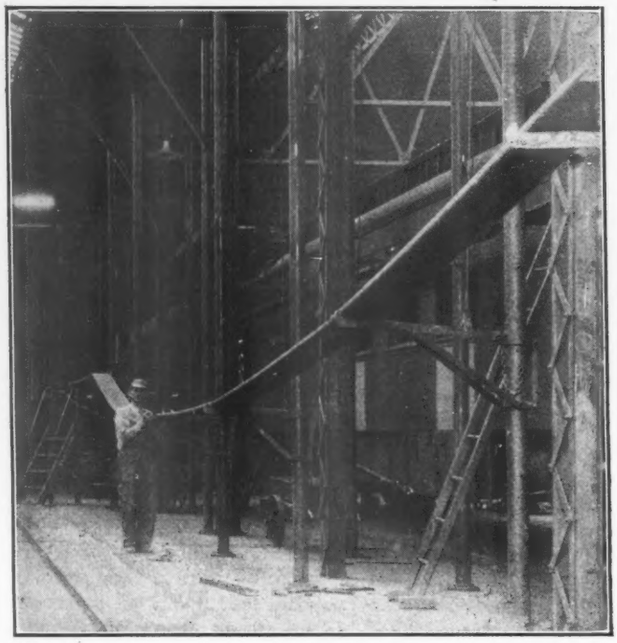
provide additional strength to the body of the car. The doors are made of steel plate stamped to fit.

A total of 82 seats are provided in the car, of which 33 are for second-class and 49 for third-class passengers. Each car is equipped with toilets, steam heat and electric lights. The style and character of this equipment, of course, varying according to the class of service.

A flexible scaffold for the coach shop

By Charles W. Geiger

A NOVEL design of scaffolding is being used in the coach shop of a western railroad which has proved to be convenient for carpenters or painters who are working on the roof or side of a car. The platform consists of 2-in. by 12-in. planks, hinged together at the ends with a pin. A notch 6 in. wide by 3 in. deep is cut in one end of the plank and a tongue slightly less than 6 in. by 3 in,, to fit in the notch of the adjacent plank, is cut on the opposite end. A hole for about a ½-in. pivot pin is drilled through the lugs formed by the notch, about 1½ in. back from the end. A pin hole is also drilled through the tongue so that the pivot pin can be easily inserted to join the two planks. Both ends of the plank are reinforced with sheet metal placed around the end and secured to both the top and bottom



The ends of the planks forming the platform are hinged together to provide flexibility

about 12 in. back from the end. The platform is supported on brackets clamped to 4-in. pipes.

The flexibility of this type of scaffolding enables the workmen to reach any part of the outside of a car and the edge of the roof with a minimum of adjustment. One or more men can work at the top of the car at one or both ends, while other workmen can work at a lower level at the center.

Another view of the flexible scaffold showing the rear construction of the metal bracket

Standard 36-ton railway passenger coach converted to motor drive by the Chicago & North Western—The car is equipped with two gasoline motor driving units built by the Oneida Manufacturing Company, Green Bay, Wis.

Balancing factors in the use of freight cars*

A discussion of the aspects of design from the standpoint of operation and utilization

By L. K. Silcox

General superintendent of motive power, Chicago, Milwaukee & St. Paul, Chicago

IN 1901 the Pennsylvania built the first 50-ton box cars because of having a greater earning capacity than the 40-ton cars. An analysis of the real benefits in operating 50-ton box cars must take into consideration two important points, viz.; can the greater loads they can carry be obtained? If so, what is the greater carrying capacity during a given period over and above the additional first cost? What is the cost of hauling the extra dead load of the heavier car?

Many thousands of 50-ton capacity box cars have been added to the equipment of the railroads in recent years and large numbers are now under construction for future delivery. It seems not inappropriate to raise the question as to whether the results obtained from the use of the 50-ton car in actual service will justify its extended employment in most localities as a standard car, in place of the 40-ton car. Will these results, when properly analyzed, not show that the 50-ton car, from a practical or commercial standpoint, can only be regarded as a specialty and confined to a particular class of traffic in a territory where the limits of its usefulness are governed by well determined lines of demarkation? An analysis of this subject necessarily involves a collection or compilation of itemized data on the essential factors that have a bearing on the relative value of this car compared with the others above mentioned. Among the most important factors are the following: first cost of the car; capacity of the car (cubic contents and car weight); average load carried in tons; conditions which militate against full load; cost of maintenance; extra cost of hauling additional dead weight when moved with less than full capacity, and extra cost for maintenance of permanent way, bridges, etc.

A fair comparison can be obtained only by actual experience with a large capacity car under operating conditions, and it should be borne in mind that such only tends to show the value of the car in the particular territory where it is in service and where the comparisons are being made. Therefore, it would be interesting and valuable if a complete report could be had of the results

*Abstract of paper presented before the Railroad Division, December 7, 1926, at the annual meeting of the American Society of Mechanical Engineers.

obtained by the use of a given number of 50-ton cars in comparison with others. This report should cover a period of two or three years, furnishing the exact figures and facts, so that others who are contemplating the addition of new and heavier equipment may be better able to reach a correct conclusion as to the type of car best adapted for the locality through which their lines may run.

Some observations of a general character may serve to emphasize certain points of more or less interest. The Union Pacific and Southern Pacific, have in service

Commodity	Car capacity, per cent
Wheat	107.1
Corn	81.7
Barley	85.1
Other grain	100.4
Ore and bullion	114.6
Coal (largely in box cars)	84.0
Coal (open top cars)	106.0
Gravel	109.0
Beets	101.4

Fifty-ton car has economic limitations

This also affords an excellent insight into the contention made by many that there is a special field for the

Type of Car	Box Cars		Automobile Cars		Gondola Cars		Hopper Cars	
Capacity in Tons	40	50,55 & 60	40	50 & 55	50 & 55	70 & 75	50 & 55	70
Detail Data in Exhibits	1	2	3	4	5	6	7	8
No. of Cars Analysed	61,822	51,027	33,941	17,850	43,428	9,655	32,083	39,829
Kind of Center Sills, No. per cent								
Channel	65	79	23	75	85	28	100	100
Fish Belly	31	21	77	25	14	72	-	-
Wood	4	-	-	-	-	-	-	-
Misc.	-	-	-	-	-	-	-	-
Total, per cent	100	100	100	100	100	100	100	100
Kind of Trucks, No. per cent								
Arch Bar	16	16	10	-	8	-	27.3	-
Cast Steel	75	82	90	87	90	100	62.4	100
Pressed Steel	4	-	-	2	.5	-	1.0	-
Misc.	5	2	-	11	1.5	-	9.3	-
Total, per cent	100	100	100	100	100	100	100	100
Kind of Wheels, No. per cent								
Cast Iron	99	99.5	100	88	7.4	-	78.4	1.0
Steel	1	.5	-	-	91.0	100	12.3	94.4
Misc.	-	-	-	12	1.6	-	9.3	4.6
Total, per cent	100	100	100	100	100	100	100	100
Width of Side Doors, No. per cent								
5 ft. 0 in.	1.8	-	-	-	-	-	-	-
5 ft. 5½ in.	1.3	-	-	-	-	-	-	-
5 ft. 6 in.	7.0	-	-	-	-	-	-	-
5 ft. 11 in.	2.4	-	-	-	-	-	-	-
6 ft. 0 in.	83.6	86.0	-	-	-	-	-	-
6 ft. 2 in.	-	14.0	-	-	-	-	-	-
7 ft. 0 in.	2.2	-	-	-	-	-	-	-
7 ft. 6 in.	-	-	-	-	-	-	-	-
9 ft. 8⅛ in.	-	-	-	2.8	-	-	-	-
9 ft. 9¼ in.	-	-	-	5.8	-	-	-	-
10 ft. 0 in.	1.7	-	81.0	80.2	-	-	-	-
10 ft. 3/8 in.	-	-	4.0	-	-	-	-	-
10 ft. 1 7/16 in.	-	-	-	1.2	-	-	-	-
10 ft. 1¾ in.	-	-	2.0	-	-	-	-	-
10 ft. 2 in.	-	-	-	1.5	-	-	-	-
10 ft. 3 3/8 in.	-	-	2.0	-	-	-	-	-
10 ft. 5¾ in.	-	-	5.0	2.7	-	-	-	-
10 ft. 6 in.	-	-	3.0	5.8	-	-	-	-
None	-	-	-	-	100	100	100	100
Total, per cent	100	100	100	100	100	100	100	100
Size of End Door, No. per cent								
23 3/8 in. wide by 28 in. high	-	8	-	-	-	-	-	-
None	100	92	100	100	100	100	100	100
Total, per cent	100	100	100	100	100	100	100	100
Style of Construction, No. per cent	-							
All Steel	-	-	-	-	42.5	82.0	83.9	100
S.U. & S.F.	-	-	-	-	14.5	2.0	9.5	-
Steel Frame	-	-	-	-	17.0	13.0	-	-
S.U. & S.S.	-	-	-	-	1.0	2.0	-	-
Steel Und.	-	-	-	-	25.0	-	3.8	-
Steel Center Sill	-	-	-	-	-	-	.3	-
Comp. S.F.& S.S.	-	-	-	-	-	-	2.5	-
Total, per cent	-	-	-	-	100	100	100	100

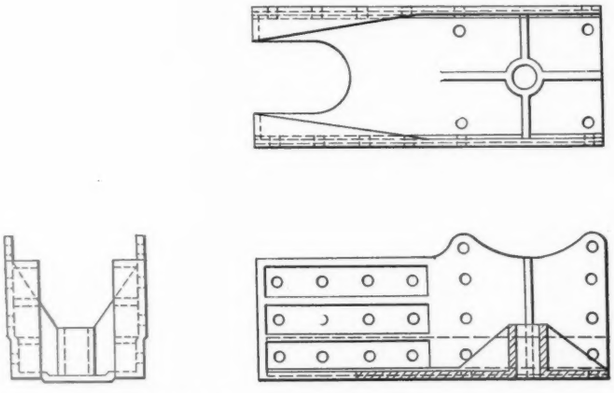
Table showing the trend in construction of box, automobile, gondola and hopper cars

thousands of 50-ton cars, and have had cars of this capacity in service for more than 20 years. Such equipment, as a rule, is loaded to a point reasonably near its capacity, for the entire haul over the owner's lines. This, of course, is an unusually favorable condition of service for the 50-ton cars and gives them the place at once among the improved facilities that count for increased net earnings. As further evidence of this, an enumeration of some of the various commodities handled at different points on the line and the quantity in percentage of the car capacity which enter into the general average attained are as follows:

40-ton car, which the 50-ton car cannot invade without a positive loss, either direct or indirect, to the operating companies. Their field is the one where such commodities as hay, merchandise, mill stuff and miscellaneous products predominate and where conditions necessitate their movement in a manner to suit the shipper, regardless of the wish of the carrier. Furthermore, it is not within the range of possibilities for the carriers to educate their shippers so as to secure the delivery of their traffic of this character for movement at a time and in a manner that will permit a prompt and full car-load movement at a specified time. Ore, coal, grain and similar

commodities, are regulated by the train load rather than by the car load and are offered for shipment at a time and in such quantities as not to require movements of less than the maximum train load.

The freight car mileage for 1925 was 26,729,831,000 miles; of this, 35 per cent was empty car mileage, which would indicate that there were many lines operated under a condition where it was almost impossible to secure loading in both directions for their cars. While this is doubtless largely the case with roads that are essentially coal or ore lines, yet much of it is in the agricultural districts where the empty mileage is box car equipment, handling an average of about 24 tons per loaded revenue car. This would seem to warrant the suggestion, if not the conclusion, that a general utility car substantially built to meet all the physical conditions resulting from interchange service, with minimum dimensions of the American Railway Association's standard box car, of a capacity not exceeding 80,000 lb. is, from some points of view, more desirable commercially, physically and financially, as a common standard for American railroads than the 50-ton car. The latter, however, has been adopted on some of the most important trunk lines and



Rear draft lug and bolster center casting

by virtue of the interchange arrangements between various roads forms no small percentage of the cars on the line which would otherwise favor 80,000 lb. capacity equipment.

It seems rather inconsistent, from a business and commercial standpoint, that large trunk lines should spend enormous sums of money in perfecting their permanent way, and other facilities for handling their business, and equally large sums in the purchase of motive power and equipment which is peculiarly adapted to their line and then a large portion of this equipment be diverted into a class of traffic and on to lines where the conditions are at considerable variance with those which hold directly opposite views as to its commercial value. While much of this modern, heavy equipment is found on roads whose officers question its adaptability to the conditions which they have to meet, a no less conspicuous feature of what might be termed unbusinesslike conditions, is the presence on the large trunk lines of a great number of small, antiquated cars belonging to the lines which do not favor the use of the large car. Many of these small cars were built years ago when the tractive force of our freight locomotives averaged about 35,000 lb. and the original construction of the cars was light. This, together with their age, renders their physical condition such that in some cases they are scarcely safe for service in light trains on local runs and are absolutely dangerous when placed in modern heavy trains handled by large types of heavy freight locomotives. Such a condition is dangerous not only to the cars themselves, but in case of accident, they are not only badly damaged, as a rule, but are the direct or indirect cause of destruction to the modern heavier cars with which they are intermixed in train service. The high cost of repairs to freight cars on some lines can be traced to the retention in service, in some cases, of light antiquated equipment that should have been retired from service immediately following the advent of modern car construction.

The more highly developed a railroad becomes in providing fast passenger service and regular freight service, the greater is the necessity for the use of good materials to prevent accidents and provide reliability of movement. When such services are offered to the public, there is imposed a moral responsibility to furnish materials which shall be equal to the service requirements.

Generally, coal cars returning empty to mines make substantially the same number of empty miles as is made on the loaded haul. There should be a decided saving in operation where larger cars are used. Furthermore, if there is a continued shortage of coal cars at mines in competitive territory during peak business, there would be a further gain in net revenue as a net result of whatever percentage of increased load obtained. Assuming the net earnings per day over and above all cost to handle, is one dollar on a smaller car, then with a larger car representing a 25 per cent increase in carrying capacity, this net would be increased to more than $1.25 a day (cost does not vary directly with capacity and the net saving will be more). If the car requires ten days to make the round trip, the increased revenue would, at least, be more than $2.50 for the round trip and would probably result in a substantial net return from the additional net revenue on the additional investment required for the larger cars, providing the peak movement under these circumstances existed during 40 per cent of the yearly period.

Cars should be designed for the service for which they are intended

In designing a car, what must be considered is the service in which it is going to run, not the service in which it may run.

One of the advantages given for all steel, steel underframe and steel frame cars, is that train resistance is less than with wooden cars. The principal reasons for expecting a lower resistance with a steel car are: first, on account of its greater rigidity there is less deflection in the bolsters and the side bearings are not in contact under the maximum load, hence, there is less flange friction and a lower tractive resistance; second, the capacity of steel cars is so much greater than that of wooden cars that it is possible to haul the same tonnage in one-half or two-thirds the number of cars, and it has been found that the increase in train resistance for a given total tonnage increases with the number of cars required to equal that given tonnage. This is to be expected from the greater area exposed to atmospheric resistance and because of the large number of wheels producing flange friction. With equal coupler clearance on straight track, there should be no difference in the resistance of the wooden and steel cars, so far as the drawbars are concerned. On the curves, however, the rigidity of the steel draft rigging prevents the coupler from accommodating itself on the normal line of the pull, and if the clearance is too small the wheel flanges are forced against the rail, thus increasing the train resistance. With the wooden car, however, the draft timbers are easily displaced or compressed and the bolts in the wooden draft attachment work to one side and the whole rigging gives enough to

provide a movement of the coupler equivalent to greater clearance and sufficient to prevent undue flange friction.

The foundation of economic efficiency in freight train service is the utilization of each car to its fullest capacity, and the first step in this direction must be taken at the origin of the traffic. The latter points, for the most part, when considered west of Chicago, are in isolated sections, not lending themselves easily to intensified supervision. It is essential that cars be in proper condition with respect to wheels and air brakes before loading because far too many refrigerator and oil tank cars are unnecessarily delayed under load for wheel changes, and for defects which should have been discovered and corrected at the last repair point before loading.

Freight cars are used in common under the A. R. A. car service rules, the per diem agreement and the interchange agreement. They are repaired (with certain exceptions) on the road where the need for the repairs develops. The average freight car of an individual road is at home not much more than one-half of the time. Obviously, if there is a common standard for the types of car used for the great bulk of the interchanged traffic, each road will be required to carry a much smaller stock of repair parts, and there will be a reduction in the time now lost by cars which are held while the repairing road is obtaining parts of special design.

Dependable cars have always been regarded as the most vital requirement upon car department executives. The consequences of the failure on the road are such that in car construction and subsequent maintenance, operating reliability is the first consideration. No feature in design, however efficient, and no maintenance practice, however economical, will ever be tolerated on our railroads, if it impairs the ability of the car to function successfully in regular train service. No saving in the cost of operating car shops and terminals will justify car failures resulting from too rigid economy in their maintenance. Nor can the time that cars are available for service be increased at the expense of the time actually required for maintaining these cars in a dependable operating condition. Next to reliability in train operation comes the efficiency of design with respect to weight, cost and structural stability.

Increase in empty car miles indicates better performance

Net tons per car load seems to remain stationary in the face of improvement in practically all other factors such as net tons a car day, car miles a car day, freight locomotive miles per locomotive day, freight cars per train, gross tons and net tons per train and average speed of freight trains. Empty car miles seem to increase by reason of better performance on the part of carriers. This situation indicates that where an improvement in other directions obtains, a decided increase in the percentage of empty mileage will result, and the sole reason for having an increase in the percentage of empty mileage comes from the fact that administrations are at present moving empties promptly, whereas when they had a low percentage of empty mileage the empties were standing still and there was a shortage of cars. It is felt by the best authorities that as long as we continue to make an improvement in the movement of business we are going to show an increase in the percentage of empty mileage compared with periods when the movement was not so prompt.

The argument is often made in favor of an all-service car for various combinations of traffic. It can be said that there is no such thing in existence as a common service box car, because the only way this could be provided would be to maintain all box cars at all times fit for the handling of the highest class traffic that moves, regardless of the fact that they may be used for that traffic only a small percentage of the time. Many administrations find it economical and proper to confine new and rebuilt box cars to the higher class traffic and not permit them to get into the moving of stone, brick, tile, cement, lime, tar and a lot of other commodities that make a car unfit for high class traffic. In the case of cars used for automobile loading, it only necessitates a few trips to make such equipment unfit for flour, sugar and other high class loading, for the simple reason that the floors are stained with oil, cars are filled with nails, spikes, cleats, etc.

The problem of unproductive weight

To whatever extent the unproductive weight of the train can be diminished, to that extent the productive weight may be increased. It is, therefore, an element of efficient use of tractive force, from a business point of view, that the dead-weight proportion of a train shall be maintained at the lowest point consistent with reliability in performance. If we were to consider the cost of hauling 800 lb. avoidable weight per car, because of using a certain feature of design instead of another of equal engineering value, and in order to save the extra weight it was necessary to pay $60 extra per car in first cost of the car, and the maintenance features were not affected, the problem would work out as follows:

Average miles per car owned per day (Includes bad orders)	28.3 miles
Cost of hauling one ton of dead weight one mile by Class I railroads varies largely from $0.004 to $0.007, so that by using the mean figure, it should be considered	$0.0055
Considering 6 per cent bad order cars, would mean 94 per cent of 365 days in service, or	343 days

Therefore $\frac{800}{2000} \times 343 \times 28.3 \times 0.0055 = \$21.36$ per year,

or $\frac{60}{21.36} = 2.75$ years to pay.

It should be understood that any figure used, such as $21.36, is more or less theoretical since the cost of hauling per ton of weight is not directly proportional to the weight carried but rather the relation of full tonnage possibilities to actual tonnage hauled. A carrier having full tonnage trains will have a lower cost per ton mile than one with variable loads of less than full tonnage.

Methods of load distribution used by the designer

Notwithstanding the claims made as to the indestructability of steel cars, the question of normal deterioration and attention required for equipment encountering yard and wreck damage and unfair usage is still a very important design consideration, in conjunction with the problem of repairs and methods and facilities needed economically to dispose of the work. Considerations of strength need to be constantly reviewed, because of changing operating characteristics of service required from freight cars.

The proportioning of the longitudinal sills in the underframe for vertical load and end shocks is an important question in freight car design. In the past there has been a wide difference of opinion as to the proper distribution of weight to each individual member, but the Car Construction Committee of the American Railway Association has made some exhaustive studies and cleared up this question, in an endeavor to lead to a sound understanding.

In rare cases, for example, in designing flat cars, concentrated load in the center of car must be considered. The present American Railway Association requirement for this class of equipment is severe and an exceptionally heavy structure is required to meet the situation. The

ballast car and coal hopper car also present a special problem as to load distribution, but in other types of freight cars a uniformly distributed load can safely be assumed, provided that the design is based upon maximum loading conditions.

It is also an open question as to how sills should be proportioned in relation to each other; that is, as to whether the center sills should carry all of the load, or whether the side and center should each carry their portion. Also in the case of cars requiring sides for containing the lading, whether these sides should act as a girder and carry the greater portion of the load. In the case of flat cars, for instance, a common method employed is to design them with deep center sills, proportioned to carry most of the load, with rolled section for side sills, figured as a continuous beam supported at the bolsters and cross bearers, and carrying a small portion of the load distributed along the sides of the car. Other administrations figure that the side sills should be made sufficiently strong to carry their portion of the load, thus necessitating fish-belly sills throughout. Such a requirement, while not universal, is sufficiently evident in normal interchange of cars designed to haul machinery, blocks of stone, tractors, etc., to make it a problem requiring thought and study at times when selection in design is made.

For steel gondolas and such cars as require sides for containing lading, and which usually consist of a web plate with top and bottom flange members, it is, of course, the most economical construction to figure them as complete girders, and so proportioned to carry the greater portion of the load, keeping in mind the necessity of providing for lateral stiffeners to prevent bulging and the collapse of the girder. The carrying of the load on the side construction, because of its depth, makes an economical girder and usually works out the cheapest, but of course would not apply to house car equipment fitted with wooden superstructure. In this case the framing should not be depended upon to carry the load, on account of insufficient strength of wooden connections, framing becoming loose on account of wood drying out and tie rods imbedding themselves into the framework, or otherwise losing their tension. It would apply, however, where the steel side sill at the bottom and the steel side plate construction at the top, form an open truss between the bolsters. In proportioning the side framing to carry a portion of the vertical load, account should be taken of the bulging pressures encountered in service under certain conditions of lading.

The draft gear and underframe

Sufficient consideration is often not given to the problems involved in providing and maintaining a suitable draft gear at the back of the coupler. Impact blows must be absorbed in some manner. These should be taken by the draft gear, and gradually and equally transmitted to the component parts of the underframe, delaying the full effect of the blow until it can be partially dissipated by the movement of the car. With the rapid disappearance of wooden cars a great amount of train flexibility by reason of the resilience of the wooden underframing, has been lost. The splicing of the center sills in front of the bolster and the use of separate draft sills to facilitate repairs was until recent years a detail which has been the source of many arguments. With the use of combination rear draft lug and bolster center casting there is no reason left for employing separate draft sills.

In common with the practice followed by the American Railway Association, the Chicago, Milwaukee & St. Paul employs combination rear draft lug and bolster center casting as shown in one of the drawings. Such construction makes it possible to deliver a maximum buffing shock with the least destruction to the car, principally because of the possibility of proper distribution to the center sills, bolster and other longitudinal members of the car. Latest practice calls for integral center sill construction from end to end of the car, some administrations using 5 ft. distance between the center line of the bolster and the face of the striking casting, in order to minimize the swing of the coupler on sharp curves and permit of shortest possible over-all length in the case of hopper cars. Others prefer a 5 ft. 6 in. distance in order to provide ideal application of the side sill step and prevent it from interfering with the opening of the journal box lid when the sill step is placed centrally under the side ladder; also to take advantage of the reduction of stresses in the car structure which is possible by reason of greater overhang on the ends of the car.

The proportioning of the bolsters depends, of course, to a large extent as to how the vertical load is distributed and carried by the longitudinal members, thereby determining how much load is to be transmitted to the center plate through the bolster. The need for taking into account the raising of the car while under load when jacks are used at the extreme end of the body bolsters, should not be overlooked. One of the most important details in bolster construction is the center filler between the center sills, shown in the drawing, located directly over the center plate. This detail must be designed to protect against fracturing the center plate and the possible tearing or bending of the bolster cover plate, thus allowing the side bearing clearance to be taken up, resulting in derailments of cars.

The improvement of couplers, draft gear and attachments promoting speedier and safer connecting and disconnecting of cars, as well as in securing them more firmly while in train service, has been accompanied by an even more remarkable development in brake apparatus for arresting the motion of the cars, either singly or in trains. Draft gears and brakes need to be systematically maintained and known to be in good operating condition, with complete stencilled identification on each car showing the date and place of last inspection and repair. While this is a mandatory practice with respect to air-brakes, it has not, as yet, been extended to the draft gears, except by individual roads. Wherever it has been practiced, the operation of the cars, their maintenance, and condition of lading carried have shown marked improvement. End construction has been particularly benefited in such cases.

Center of gravity is too high in some types of cars

Another feature, respecting freight car design, which is often not sufficiently considered, has regard to the permissible center of gravity of cars under load. Experience has shown that 6½ ft. from the top of the rail is about all that is safe for ordinary service, and, yet, many of the large sized hopper, automobile and furniture cars are operating under load with centers of gravity in excess of 7 ft. This is the main reason why so many derailments and wrecks occur with cars 10 ft. high inside and loaded to the roof. Strictest care is necessary in train handling and track maintenance on curves in order to minimize that element of danger.

The diagonal brace, which is usually placed in all underframes at the corners, is a detail which varies according to the ideas of the designer. Some advocate extending it from the ends of the center sill to the intersection of the side sill and bolster. Others prefers to have the brace extended from the corner to the center sill at the bolster. The former arrangement relieves the center

sill of a portion of the buffing shocks, transmitting them to the sides; also any cornering of the car sufficient to damage it to a considerable extent would be great enough to damage the brace if it extended from the corner of the car to the intersection of the center sill and bolster. Without the brace at the corner, the underframe is more easily repaired. However, on cars where push pole pockets are used to a large extent, it is quite important that the brace be provided in the latter location to transmit the thrust to the center sill. The employment of roping staples located at or near the bolster has largely done away with push poles and more cars are being pulled instead of pushed in spotting them; this is particularly true at mines, logging camps or industrial tracks.

Much difficulty is being experienced at this time, with truck coil-springs under 50 and 70-ton capacity cars, on account of existing designs going solid under load and causing breakage. A freight car truck spring has necessarily to work through a tremendous range of carrying capacity, namely, that of the light weight of the car body as a minimum, and this weight plus the full carrying capacity of the car, which is generally equal to five or six times the light weight, as a maximum. While space restrictions are significant with the conventional design of truck, the provision of a safe spring, namely, one that will allow (1) the car to remain on the track and (2) not permit the load to punish the track unnecessarily, are important considerations. Some roads are resorting to the addition of springs in order to give greater cushioning capacity, others are employing improved material and still others are modifying the shape of the bar forming the coils in order to attain greater capacity and more travel. The bar of steel forming the spring should not be any larger than absolutely necessary in order to allow of proper heat treatment. It is quite possible that with the increase in freight train speeds being demanded at this time, new designs of trucks will be required to provide greater safety, and certainly to relieve the truck springs of the tremendous side thrust action they are now subject to. Lastly railroad spring shop practice may be largely benefited from a study and application of methods employed in the automobile industry.

The introduction of all steel or steel frame cars began when the first of the modern steel cars were built about 1897, yet we have record of steel cars having been built, to a limited extent, as far back as 1853, and in much larger numbers a few years later in Europe. The Eastern Railway of France alone in 1905 had over 20,000 cars with metal framing or all metal construction in service. Taking the year 1907 as a base and one of the normal operation in the car building industry, the returns from 367 car building concerns indicate 284,188 freight cars built, of which 72 per cent were of all steel or steel underframe construction. The proportion of steel cars to wooden cars built emphasizes the rapidity with which the introduction of metal into freight train cars took place, from this period on.

One of the tables shows the percentages of a total of 289,637 cars built by six of the leading car building companies in the country over a period 1921 to 1926 inclusive, having different features of construction. This table includes 40, 50, 55 and 60-ton box cars; 40, 50 and 55-ton automobile cars; 50, 55, 70 and 75-ton gondola cars, and 50, 55 and 70-ton hopper cars.

Of the number of cars shown, 31.8 per cent are of all steel construction; 15.3 per cent are of steel framed construction with wooden lining; 52.9 per cent with steel underframe and double sheathed wooden superstructure; 100 per cent with steel center sills. So far as trucks are concerned, 89.2 per cent are equipped with cast steel trucks and 10.8 per cent with other than cast steel trucks; also 81.2 per cent are fitted with cast iron wheels and 18.8 per cent with steel wheels. The average light weight of all cars per cubic foot carrying capacity was 19.85 lb., ranging from a minimum of 12.24 lb. to a maximum of 34.27 lb.

Standardization of castings and forgings

The designing of the modern all-steel and steel framed car up to the year 1912, was left largely to the car builder, in conjunction with, and often under the supervision of railway mechanical officers. This was because of the fact that this type of construction was at that time quite new and it was necessary for the manufacturers to design and present the many advantages to be gained in substituting steel for wood in car construction. This period was followed by the larger systems taking up the designing of their steel car equipment on quite an extensive scale. They consequently not only furnished builders with complete specifications covering the construction of the car, but also an engineering analysis of all parts and detailed drawings, including bills of material.

Both arrangements have their advantages and disadvantages. In the case of a railroad designing its own cars, it is possible to standardize its castings, forgings, and miscellaneous parts to a considerable extent, and, by keeping in mind its standard cars of different classes, it is often able to design them in such a manner as to have several parts common to all classes, thereby assisting to reduce the investment for repair parts, as well as making substitutions conveniently. This, however, often works out to the disadvantage of the car builder, as he, too, has standard patterns, etc., which, of course, are to his advantage to employ. These standards may differ from the railroad company's standard just enough to necessitate new dies and patterns to such an extent that the saving gained in having the drawings, specifications and bills of material furnished is more than offset by die and pattern expense. These dies may never be employed on later orders, which means, of course, that the entire die and pattern cost must be borne by this particular order of cars.

In the case of large orders this cost, distributed over the entire lot, would not represent as important a charge per car as in the case of a smaller order, but it is a serious factor to be taken into consideration in estimating and designing. The number of complicated shapes should, therefore, be kept as low as possible. It is essential that a maximum standardization of all castings and such forgings as might be termed running repair parts, such as brake gear, draft gear, safety appliances, etc., should be standardized as far as possible, in order to attain economical manufacturing shop practice and road running repair maintenance. The need for standard construction,' where practicable, should be emphasized constantly.

While the American Railway Association has accomplished admirable results in the way of standardizing car designs, truck parts, draft gear parts, etc., this endeavor cannot be made successful unless taken seriously by the various large administrations in the purchase of new equipment.

The question of limiting stresses to be used in the design of cars needs to be thoroughly understood and carefully applied. The following is offered as a recommendation and is based upon exhaustive studies made with respect to A. R. A. standard car designs now being developed to a conclusion:

1—Unit stresses.
Structural steel:
Tension ..... 16,000 lb. per sq. in.
Compression for columns whose ratio of length to least radius of gyration is less than 40.... 16,000 lb. per sq. in.
For columns whose ratio of length to least radius of gyration exceeds 40, determine the maximum unit compressive stress at the center of the column due to a direct load by means of the Rankine formula, fixed ends, transposed as follows: $S = \frac{PC}{A}$

where
S = Maximum unit stress in lb. per sq. in. in a long column due to a direct load.
P = Direct compressive stress in lb.
A = Area of section in sq. in.
$C = 1 + \frac{1}{25{,}000} \frac{(L)^2}{(r)}$
L = Length of column in inches.
r = Least radius of gyration in inches.
For ends of columns, where the bending movement due to slenderness ratio is neglected.... 16,000 lb. per sq. in.
Shear ..... 12,800 lb. per sq. in.
Rivets:
Shear ..... 10,000 lb. per sq. in.
Bearing ..... 20,000 lb. per sq. in.
Wood:
Tension ..... 600 lb. per sq. in.
2—The car body should be designed to carry under service conditions the maximum rail load limit prescribed.
3—Center sills should be designed to withstand
a—An end load of 250,000 lb. per sq. in. applied on the back stop at the center line of the draft.
b—Weight of center sill and attachments.
c—Vertical load reactions of floor planks.
4—Bolsters and crossbearers should be designed to carry
a—Total reactions from the side sill for the bolster, and center sills for the crossbearer.
b—Weight of the bolster or crossbearer attachments.
Only the cover plates of bolsters and crossbearers should be considered as effective in resisting bending moment.
5—All connections should be designed for the maximum load to which the member connected may be subject and so detailed as to eliminate insofar as possible eccentricity effects within the members. Where it is not possible to eliminate secondary stresses in any members caused by eccentric loads these should be combined with the direct stresses in such members.

Conclusions

Railroads should systematically consider the current requirements of the service as they become increasingly apparent from year to year in view of enlargement in traffic and the ever changing conditions of operation.

Maintenance policies need to be formulated far in advance, in order to maintain currently and turn over a proper number of cars by classes, and to employ the least complement of facilities and labor force regularly to keep the entire plant structure working efficiently and uniformly to the greatest reasonable degree and, yet, with a maximum economical output.

Railroads should adhere to a 20 to 25 year life for freight train cars with an annual depreciation rate to coincide with whatever figure is used and provide for suitable and current replacement.

Railroads should procure freight train cars when built new embodying the design fundamentals recommended by the A. R. A. and of minimum weight consistent with traffic and engineering considerations.

Railroads should give constant thought to the fact that freight train cars should be built interchangeably between roads insofar as possible in order to lessen first cost and improve current maintenance when cars are off the line and also to avoid delay when needing repairs which may be occasioned when special repair material is needed.

Special classes of cars should not be built unless they are really justified from the standpoint of actual traffic and operating experience factors.

Interchange Inspectors' discussion of new rules

Differences of opinion were expressed over the meaning of Rules 2, 17, 36, 66 and 75

IN addition to the presentation of papers, abstracts of some of which have been published in the two preceding issues of the *Railway Mechanical Engineer*, the last two sessions of the Chief Interchange Car Inspectors' and Car Foremen's Association convention, held at Chicago, September 21 to 23, were devoted principally to the discussion of the new interchange rules. The discussion is abstracted in this issue.

Discussion of freight car rules

Rule 2

New form—(f) *Transfer authority will not be issued on account of the following defects (Included in new paragraph 1 and 2):*

1—All truck defects on home care.
2—All truck defects on foreign cars; except *defective* metal bolsters or center plates cast integral therewith, *defective* truck sides and transoms, defective non-A. R. A. standard journal boxes where the A. R. A. standard is not a proper substitute.
3—Defective outside *wood* end sills, all cars.
4—Defective body center plates where not cast integral with bolster, all cars.
5—Defective *or missing* body center plate bolts *or rivets, whether or not they pass through center sills,* all cars.
6—Defective *or missing* center pins.
7—Renewal of any *or all* roof boards on outside *wood* roofs and inside metal roofs, where purlines, *carlines,* ridge pole and plates are in good condition, all cars.
8—Defective or missing side doors, end doors, roof doors and hatch covers, all cars.
9—*Any other defects which can be repaired under load, or if car is safe to run and safe for lading, the receiving line to be the judge. Note: The word "Defective," as used in the foregoing, is intended to mean that the part or parts referred to are defective to the extent that, in the judgment of the receiving line, immediate repairs or renewal are necessary.*

(g) A. R. A. car service Rule 14 will apply when transfer or rearrangement of lading is necessary, including application of proper door protection as required by the loading rules.

Reason—To facilitate the movement of cars through interchange and avoid unnecessary transfers.

M. E. Fitzgerald (C. & E. I.): Is this the rule proposed or is it the change which has been approved by the A. R. A. Committee?

T. W. Trapnell (C. I. I., Kansas City, Mo.): They are approved and will be effective January 1, 1927.

T. J. O'Donnell (Buffalo, N. Y.): Note 9 of Rule 2, is entirely new and the latter part of it says "that in the judgment of the receiving line immediate repairs or renewal are necessary."

J. J. Gainey (Southern): The rule states that the receiving line will be the judge. A few lines further up it states that the receiving line will be the judge as

long as there is no chief interchange inspector there to judge.

Mr. O'Donnell: I would like to ask Mr. Gainey if he is giving away any Southern money by making transfers where transfers are not necessary.

Mr. Gainey: I still say that the receiving line is the judge as to whether the car is safe to run over that railroad or not. If he is arbitrary and says the car is not safe to go he has the right to transfer it and I have to pay the cost of transferring.

President Elliott: I remember in discussing the question one of the chief interchange inspectors said the car was not safe to run and the receiving line would not run it and I think that is what the Arbitration Committee had in mind.

Mr. Fitzgerald: We will not have any great amount of trouble at points where chief joint inspectors are located. They know the regulations covering these things and they would say that if the receiving line decides not to run the car they should transfer it at outside points at their own expense. This rule still leaves the question up to the receiving line and it is their decision whether or not they want to run the car. There is nothing in the rule which tells you to make certain repairs. It is a question of studying the rule and we will not have any trouble.

Mr. O'Donnell: I disagree with Mr. Fitzgerald. I interpret the Arbitration Committee's decision that the cost of transferring is against the delivering line, but there are defects that will not permit the reloading of cars. I maintain that we should take away from the receiving line some of the feeling that it can do as it pleases.

W. R. Rogers (C. I. I., Youngstown, Ohio): It seems to me that the Arbitration Committee expects us to use a little ordinary good judgment in regard to this question. The receiving road is still the judge as to what defects will be repaired under load or run, but it is the intention to repair reasonable defects.

C. J. Nelson (C. I. I., Chicago): It is my impression that the rules of interchange referring to the transferring of cars is intended to only serve as a guide. It would be absolutely impossible for the Arbitration Committee or any other committee to build up a set of rules that would indicate to the man in the field the kind of defects for which a car could be transferred, so it seems to resolve itself into a question of exercising the best possible judgment. The rule is plain enough in designating to each the authority to say whether or not that car can be handled over the receiving line's rails. There is no question but what the receiving line has the right to decide whether or not transfer is to be made.

Mr. O'Donnell: I make a motion that it is the sense of this body that Article 9 of Rule 2 intends to convey to all interchange points that the lading of the car must not be disturbed unless the car is absolutely unfit for further handling of the load it carries.

The motion was lost.

Mr. Trapnell: I do not believe this body has a right to approve an interpretation of an A. R. A. Rule. I move that we as Chief Interchange Inspectors understand the rule as published in this book to facilitate the movement of the car, that rule will go into effect the first day of January, 1927.

The motion was lost.

Rule 4

New form—In the case of damage to a car by unfair usage, the handling line must, at the first available inspection point, attach defect card to cover. If the car is in shop and a portion only of the unfair usage damage is repaired, defect card must be applied before car leaves the shop. If a car is offered in interchange with delivering line defects, the receiving line shall require that a defect card be securely attached to the car, as per Rule 14.

Reason—It is felt this requirement will improve the situation at interchange points.

M. P. Williams (Michigan Central): Many of you who have had to do with the education of inspectors and repair track supervisors should try to educate them along the lines of this rule If the car is damaged on our line we can put a defect card on it rather than see it get by interchange points when we do not put a defect card on the car at the time the damage is done. The car passes one or two interchange points and the next chief interchange inspector is alert and catches it. That places the burden on another line, which is wrong. What we should do is to go into this wholeheartedly and tell our men we want to protect the owner on all the damage we do. If you have a car side-swiped and you do not want to repair it then, at least explain it by putting your defect card on it. Do not take a chance on putting it on at the next interchange point.

Rule 7

New form—All items carrying labor charges must be covered in proper detail on the original record; the time or money charges (as per Rule 107 and 111) need not be shown. For items of labor computed on the rivet basis, the number and diameter of rivets, *and purpose for which used,* must be shown on original record. For items of labor for straightening or repairing, computed upon weight basis, the weight of material must be shown on original record.

Reason—To enable the car owner properly to check repair bills.

John J. Whelan (B. & O.): The proposed change will work a hardship on the billing clerk in place of the car owner and will make additional work in his office in checking the foreign bills. You will have to check seven or eight steel repair shops and the clerk billing out the work will have to make a great many multiplications. When you only multiply once you can go over it once to avoid an error. I do not see how it will help the carmen because they do not have time to count the number of rivets they used in a car. When the owner receives the bill for the defects on a steel car he can estimate whether or not that bill is proper. If the bill is exorbitant he can take exception to it and return it to the repairing line.

Secretary Sternberg: I am somewhat surprised at Mr. Whelan. We have to check against the tank car people and they do not tell us where they put the rivets. I think this will clarify the rule and you will have less work answering exceptions taken to bills than in writing extra repair cards.

T. S. Cheadle (R. F. & P.): If I have seven or eight rivets in a center plate, and seven or eight more in a coupler stop what will I do?

Secretary Sternberg: Designate them.

Rule 17

New form—If the car owner elects, on account of improper repairs, to remove an A. R. A. standard coupler, A. R. A. type D coupler or A. R. A. Temporary Standard coupler in good condition, secondhand credit should be allowed, *and charge for coupler confined to secondhand value.*

Reason—To clarify the intent of the rule.

Mr. Rogers: Does the A. R. A. standard and recommended practice show a standard coupler other than "D" type? If not is the A. R. A. standard coupler referred to the former standard coupler? If so, why don't they all say former standard coupler?

Henry Andrews (N. Y. C.): It occurs to me that during 1911 when the safety law first went into effect, we had to have certain end line clearance, it was permissible to apply a 12½-in. head coupler which afforded a 10-in clearance. It is my understanding that is what is meant by this interpretation. We should have the A. R. A. 9¼-in. head and the 10¼-in. head and the A. R. A. knuckle.

V. R. Hawthorne (Secretary, Mechanical Division, A. R. A.): Mr. Rogers' question is well taken; the rule should say "former." The committee is revising the rules and will take care of that.

Mr. Fitzgerald: What I cannot understand in this proposed rule is why, assuming that a railroad applies a type "D" coupler and we own the car, a bill is rendered against us and we pay for that particular coupler. It belongs to us and if the car comes back and we take that coupler out why should we give the road any credit for it?

W. J. Owen (P. & P. U.): As I understand it, that rule refers only to wrong repairs, for instance, you put a 6-in by 8-in. coupler in place of a 5-in. by 7-in. or a 5-in. by 7-in. in place of a 6-in. by 8-in., or a 5-in. by 7-in. in place of a 5-in. by 5-in., that would be wrong repairs.

Mr. Fitzgerald: Very few roads are making wrong repairs without billing. I am going to assume that you repair a car and put in a wrong coupler, when I take that coupler out I have already paid for it and when I repair the car I am entitled to bill for the repairs, but I do not understand why after I have paid him for the coupler I should turn around and give him credit for it.

S. M. Martin (B. & O.): The rule says A. R. A. standard coupler type "D." The rule is written for the purpose of keeping roads from going back and applying the old standard again. It is an incentive to get to the new standard coupler.

Rule 32

New second paragraph—Combination outlet valve and plug missing from tank car where car is stencilled that it is so equipped.

Reason—It is felt that this item should be protected in interchange.

J. D. Ernst (Illinois Central): On this combination outlet valve and cap plug, should it not be outlet valve cap?

Mr. Hawthorne: That is correct and will be corrected in the rules this year.

Mr. Rogers: Will someone who actually knows, tell me just what this combination outlet valve and plug is?

Mr. Hawthorne: The committee will try to clarify that in the rules before they are printed.

Rule 36

New second paragraph, Section 3—Missing placards or certificates on cars containing explosives and other dangerous articles must be replaced. Placards, *commodity cards* and certificates on empty cars, except as provided in paragraph 1056 of the Interstate Commerce Commission Regulations, must be removed, etc.

New form of interpretation (2)—Q. Paragraph 3 states that inflammable cards, *commodity cards* and certificates on empty *tank* cars must me removed; may such cards be removed from empty cars and defect card issued against delivering line?

A. Yes, except optional empty tank car card as provided in paragraph 1056 of the Interstate Commerce Commission regulations.

Reason—To clarify the intent of the rule.

M. P. Williams (Michigan Central): The commodity card referred to in the second sentence is probably the same as that mentioned in the first sentence, but if a car loaded with gasoline is offered in interchange carrying placards, you say that such cars require a dome or commodity card.

The Chairman: The commodity card is about 6 in. by 8 in. and designates the shipper, the consignee, and tells what the car contains.

Mr. Williams: In other words, the commodity card does not refer to the gasoline card that is required to be placed on the side of the tank or on the running board.

Secretary Sternberg: I think the rule refers to all commodity cards.

James Harris (Mo. P.): This is not the regular form of commodity card, it is a little card marked gasoline, fuel oil, acid or whatever the car contains.

Mr. Williams: Do you call that the routing card?

Mr. Harris: The M. C. B. red book gives them as commodity cards.

Mr. Williams: That is my interpretation of the commodity card. I think that is something that should be ironed out here.

H. W. Bayliss (Pere Marquette): There is a kind of commodity card used on these tank cars which gives the point of shipment, loading and consignee, which is put in card containers and is the commodity card referred to.

Mr. Hawthorne: I think Mr. Williams is correct. It is the card which says gasoline or gas, oil, and these cards are being removed from cars. This question came up last year, raised by some of the oil shippers. It does not refer to the routing card that Mr. Elliott had in mind.

Secretary Sternberg: Any card that conveys information as to the contents of the car is a commodity card.

W. J. Owens (P. & P. U.): Rule 36 covers the commodity card in Section 2.

Mr. Williams: The first sentence of the proposed form does not mention commodity cards on cars containing explosives, but the second sentence states that placards, commodity cards and certificates on empty cars must be removed. If the word commodity card is also referred to in the first sentence, then that makes the road on whose line the car was loaded responsible for the car which was loaded. If you say take them off when the car is empty, why not say put them on when the car is loaded after they are received. The rule as now printed does not cover that. I think they should put in the words "Commodity Card" in the firse sentence.

Mr. Cheadle: As I understand it the rule requires you to take them off when car is empty, but does not require you to put them on the car when loaded.

Mr. O'Donnell: I do not think that is the intention. Commodity cards are considered on any class of equipment and I think the Arbitration Committee intended to provide for that by requiring these cards. It does not refer only to the Bureau of Explosives cards, you have them on other cars. That is the commodity card in the strict sense of the rule. Why shift to loaded cars when we are talking of about empty cars?

Secretary Sternberg: Is a commodity card considered an advertisement?

Mr. O'Donnell: No.

Secretary Sternberg: If it is not considered an advertisement there is no difference whether or not you remove it.

Mr. O'Donnell: This rule covers all cars, and is just as much applicable to box cars, or refrigerators or any other cars. The Arbitration Committee have rules that the commodity cards should be removed when the car is unloaded.

M. P. Cole (Belt Ry. of Chicago): It would appear

to me that the rule of the Arbitration Committee is well taken. There is no change recommended in Rule 36, items one or two, and my understanding is that the commodity card is permissible on all loads, the only change recommended applies to tank cars.

Rule 66

New form (owners responsible)—(a) *Periodic repacking of journal boxes, after the expiration of twelve months, as indicated by the stenciling on car, regardless of the responsibility of handling company for change of wheels or other repairs.*

(b) *All journal boxes shall be jacked; all journal wedges and bearings removed for examination, and renewed where necessary; all boxes cleaned and repacked with properly prepared packing (new or renovated) in accordance with A. R. A. recommended practice, and car stenciled. Dust guards shall be renewed, when necessary, only where wheels or journal boxes are changed.*

(c) The date and place (railroad and station) where *this* work is done *shall* be stenciled on car body near the body bolster at diagonal corners *with not less* than 1-in. figures and letters, using the same station initial *as* is used for airbrake stencil. *This provision also applies to new cars.*

(d) No change *shall* be made in the stenciling unless all boxes are repacked *and the work complete, in all details has been performed.*

(e) *If car bears no stenciling showing date of previous repacking, all boxes may, if necessary, be repacked in accordance with paragraphs (b) and (c).*

(f) *This work shall be done only when cars are on repair track for other repairs.*

(g) *No charge shall be made for repacking, etc., if performed within twelve months from date stenciled on car.*

(h) *No charge shall be made for repacking, etc., unless all boxes are repacked and the work complete, in all details, has been performed.*

(i) *Work performed, in accordance with the foregoing, to be charged to car owner at prices specified in Rule* 101.

(j) *Journal bearings having back or lug broken or cracked, or length reduced ⅜ in. or more, or lining loose, cracked, broken, spread over side or worn through to brass, shall be considered as requiring renewal.*

(k) *Journal bearing wedges, cracked, broken, or top radius worn flat lengthwise of wedge, shall be considered as requiring renewal. Care must be taken to see that wedges are not scrapped account worn unless top radius is actually worn flat.*

(l) *The periodic repacking, etc., does not contemplate any change in the ordinary attention as to oiling and packing when necessary.*

The A. R. A. Recommended Practice, as mentioned in paragraph (b), *is as follows:*

P. J. Hogan (N. Y. N. H. & H.): Is it necessary to state journal boxes jacked or repacked, showing the station, date and name of railroad?

Mr. Hawthorne: The statement in Rule 9 covers that.

B. F. Jamison (Southern): The stencil should show the length of journal, name of road and date of last previous repacking.

Mr. Hogan: The stencil is what I am after.

Mr. Hawthorne: The stencil is covered by a later pamphlet of the Committee of Car Construction on stenciling the letters on cars.

Mr. Hogan: If the top radius of the journal wedge is worn flat this flat wedge should be specified. A specific flat spot should be inserted in the instructions.

Mr. Hawthorne: In that connection I would say that the Committee on Car Construction has on its docket the matter of journal wedges and undoubtedly that committee will have something to report.

Mr. Cole: Referring to item *J*, I wonder if the gentlemen are aware that the journal bearing which they are now applying are all running short, in other words the journal bearings measure 7x¾ in. We have taken actual measurements on our line, as well as on others, and we find that these conditions exist. This is a matter for the Arbitration Committee to consider and also for the representatives of the various roads, which are here, to take home and perhaps help get after the manufacturer to give you the length of the brass you desire.

F. A. Ryan (N. Y. C.): Does Rule 66 apply to owners' cars. I had a discussion on that just recently and it was found that the car owner did not have to comply with the details outlined in Rule 66 in repacking his own car. It seems what would have to be done on foreign cars would have to be done on home cars.

The Chairman: As I understand it, the rule applies to home cars as well as foreign cars.

Mr. Williams: I would like to refer to section *F* of the proposed form, which states, "This work shall be done only when cars are on repair track for other repairs." There are a large number of bill clerks here, and this is one of the things we are going to have a lot of trouble on.

George Smith (C. & E. J.): The application or interpretation in Rule 60 would apply in Rule 66. In case of air brake, there is three months in which the work might be done if it is necessary to shop the car, while in Rule 66 the packing is out of date.

Mr. Williams: That is not what I meant. If I have one of your cars up in my train yard I have no authority to repack that car because it is over date, and I cannot put it on the repair track for repacking only. If the repacking date is more than twelve months old, am I justified in repacking your car?

Secretary Sternberg: I see nothing to prohibit you from marking a car to your repair track to repack a journal box if beyond twelve months, providing that car requires other repairs.

J. E. Gordon (N. Y. C. & St. L.): The intention of that rule is that no car can be packed unless it has a mechanical defect.

C. J. Wymer (C. & C. I.): The committee had in mind that the work was not sufficiently important to justify taking the car out of service and delaying it for repacking alone, and in order to justify the charge the car must require other work than repacking the journals.

C. W. Kimbell (Southern): Any previous marking would show the date that work, if necessary, may be done. Does that mean the cleaning or is it the condition of the packing that would cause you to clean it off? If one box needed packing before the other, would that give you authority to repack the others?

The Chairman: If the car is not stenciled you can pack the boxes.

E. S. Swift (Wabash): When we had this rule before we had to make a special repair card. How are you going to tell whether there are other repairs if you have to make special bills for repacking the journal boxes? How is a bill clerk to check to see what other repairs were made?

W. F. Armstrong (B. & O): A car is given to me with four pairs of slid flat wheels with a defect card attached. The question was asked me if I would apply wheels on the authority of a defect card. May I render a bill for the application of the slid flat wheels and then pack those same eight boxes, stencil the car and charge to the owner?

Mr. Gordon: If you have a car in your charge with four pairs of slid flat wheels and no stencil mark on the car, you can charge for packing the boxes.

Joe Martin (N. Y. C.): Paragraph A of the rule as written covers Mr. Armstrong's case.

Rule 70

New form, first two paragraphs—Cars stenciled "wrought-steel wheels" *or* "1-*W wrought steel wheels,*" if found with cast-iron, cast-steel or steel-tired wheels. *Cars stenciled "wrought-steel wheels," for one end of car only, if such end of car is found with one or both pair cast-iron, cast-steel or steel-tired wheels.*

Cars stenciled "cast-steel wheels," if found with cast-iron or

steel-tired wheels. *Cars stenciled "cast-steel wheels," for one end of car only, if such end of car is found with one or both pair cast-iron, steel tired or 1-W wrought-steel wheels.*

Reason—To afford protection to car owner in the application of wheel betterments to one end of car.

Mr. Williams: This may be the intention, although we do not know the necessity and use of everything. The second paragraph of the proposed form says, "Cars stenciled cast-steel wheels" if found with cast-iron or steel-tired wheels. Cars stenciled "cast-steel wheels," for the end of car only, if such end of car is found with one or both pairs cast-iron, steel-tired or wrought-steel wheels. In the first sentence no mention is made of steel-tired wheels, but later on it says cast-iron, steel-tired or wrought-steel wheels.

Mr. Hawthorne: Mr. Williams is correct. That is a typographical error, and will be taken care of in the revision of the rules. In preparing this report at Atlantic City this part was changed by the Arbitration Committee to provide for the application of wrought-steel wheels.

Rule 75

New rule (formerly second paragraph, Rule 71)—Brake burn: Wheels having defective treads on account of cracks or *combiness* due to heating.

Reason: As recommended by the Committee on Wheels.

Mr. Cheadle: It says "on account of cracks or combiness due to heating." Cracks in the center of the wheel do not effect it a great deal. I want to know if it is necessary that these cracks cross the center of the wheel, or any cracks whatever.

The Chairman: You will have to read Rule 71 to get your answer. It says, if it does not affect the serviceability of the wheel.

Mr. Hawthorne: I think he will get the information he wants from the Wheel Committee's report.

Mr. Ryan: If you have brakes left set and you heat the wheels until they are elongated and cracked, is that handling line or owners' responsibility? Is that term the same as a brake burn?

Mr. Fitzgerald: I do not know why any railroad company would ask a car owner to pay for a car damaged as you say due to his operation with set hand brakes. On my road I would say, "No Bill."

Mr. Ryan: On the bills we are getting, they say, "Brake burn due to hand brake set."

Mr. Fitzgerald: That may be done, the wheel may become heated and blistered, and they would bill the car owner for the damaged wheel.

Mr. Ryan: An overheated wheel is heated the entire circumference. The tread becomes full of small cracks and that is the defect that seems to be at issue at the present time. I do not think that this condition should be considered a brake burned wheel.

Secretary Sternberg: If you can establish the fact that the hand brake was the cause of the overheated wheel, you could reject the charge. There are some places where they set the retainer up in such a position as to sometimes cause overheating and brake burn and that is owners' responsibility.

Mr. Ryan: Is it the sense of the rule that an overheated wheel and a brake burned wheel is one and the same thing.

Henry Andrews (N. Y. C.): The Wheel Committee answers that very plainly in Section 8 of their report.

Discussion of passenger car rules

Rule 15

New sentence in Section C—Air-brake hose applied must be new and made in accordance with specifications for A. R. A. standard 1⅜ in. hose, and so labeled.

Similarly, to justify bill, steam or signal hose applied to foreign cars must be new and made in accordance with A. R. A. specifications.

Reason: It is felt that new hose should be used in repairs to foreign cars.

Mr. Owen: The intention is that we must apply new hose to foreign cars, regardless of whether it is a handling line or owner's responsibility; that we cannot apply second-hand hose even if it is a handling line's responsibility.

Mr. Hawthorne: You can put on the defect card, but this is a billing proposition, and you must put on new hose if you are going to make a bill.

Mr. Owen: As I understand it, you do not have to apply a new hose when it is a delivering line's responsibility. I would like to have some explanation of that.

The Chairman: If I loose off an angle cock and hose, have I the right to put on a second-hand air hose?

A. Kipp (N. Y. O. & W.): I think you have a right to put on a second-hand hose if you wish, but you cannot bill for it. They would not accept the bill if you offered it.

Mr. Smith: The proposed form is very clear. The new form should be applied simply to justify bills. Steam and signal hose must be new and application made in accordance with the A. R. A. standard. In order to justify a bill only a new hose must be used.

Mr. Fitzgerald: No provision is made for bill in the rule now in force. You have to give the owner new hose under the rules we are now working under.

The Chairman: That is my idea. We have on hand at our reclaim yard several thousand second-hand air hose, and we have applied new ones in place. It is very bad practice to apply second-hand hose.

Mr. Hawthorne: The Arbitration Committee have been listening to your arguments and there is an apparent confusion in Rule 15 in the second sentence. They will give that matter consideration and try to make it clear. I think it is a bad practice to put second-hand air hose, steam or signal hose, on even your own cars.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Damage not associated with unfair usage defects

Great Northern box car No. 220075 was repaired by the Chicago, Rock Island & Pacific for which a repair bill was rendered for the amount of $3,859.26. The C. R. I. & P. admitted that the car was chained to another car from which the coupler was missing but it contended that it did not charge for any repairs which were the result of any such handling. The Great Northern contended that there were a number of items charged which should have been marked "No bill," stating that upon taking up the matter with the Pennsylvania which delivered the car to the C. R. I. & P., it was advised that the car had had no bad order record against it when interchanged. This was considered by the Great Northern as an authentic record and that all the repairs made to the car were the result of unfair usage as prescribed by

Section 5, Paragraph E, Rule 32, and contended that the C. R. I. & P. should authorize a counterbill for the entire amount charged. The C. R. I. & P. admitted that when the Pensylvania delivered the car it had had no bad order record against it, but the reason for this was that the inspection and carding in the Chicago terminal district is done by the receiving road.

The Arbitration Committee in rendering its decision sustained the contention of the Chicago, Rock Island & Pacific.—*Case No.* 1377, *Great Northern vs. Chicago, Rock Island & Pacific.*

Joint statement not conclusive evidence for repairs claimed not made

On December 5, 1923, St. Louis & Belleville Electric car No. 658 was repaired on the lines of the Chicago, Milwaukee & St. Paul. Among the repair items listed were eight truss rod turnbuckles tightened which the C., M. & St. P. claimed that the owner refused to pay for on the grounds that the work had not been done. The owner stated that it had received and approved for payment a bill for $36.70 which covered all of the items listed by the repairing line, and that the claim of the repairing line that it had not been paid for tightening the truss rods was incorrect. However, the owner held the car, when it arrived on its lines, for the reason that it had received from the Great Northern a bill covering the tightening of eight turnbuckles 28 days previous to the time the C., M. & St. P. billed it for the same work. After accepting the car, the owner maintained that it could not find any evidence that the turnbuckles had been moved on the rods. A joint statement and the repair cards of the Great Northern and the C., M. & St. P. were submitted as evidence that this work was charged by both lines, which, the owner contended, carried the same authority as the joint evidence card when covering wrong repairs, and which entitled it to a recharge authority for the amount paid the Chicago, Milwaukee & St. Paul for trussing this car.

In rendering its decision, the Arbitration Committee stated, "The charge of the Chicago, Milwaukee & St. Paul Railway is sustained. The principle of Decision No. 1150. applies."—*Case No.* 1379, *Chicago, Milwaukee & St. Paul vs. St. Louis & Belleville Electric.*

A case where Rules 32 and 43 do not apply

The Terminal Railroad Association of St. Louis inspection certificate dated June 6, 1924, covering the condition of Louisville & Nashville box car No. 64320, was forwarded to the L. & N. with a letter dated June 18. explaining that the estimated cost of repairs exceeded the allowance under A.R.A. Rule 120 and the L. & N. was requested to furnish disposition of the car. The T. R. A. contended that the case did not come within the provisions of the footnote of Rule 43 and that there were no requirements that a statement of the handling of the car should be furnished It contended further that the damage to the car did not come under the provisions of Rule 32 and that the defects on the car were owner's liability. The L. & N., upon investigation, found that the car was damaged as a result of four cars loaded with grain being released without rider protection, which permitted them to collide with L. & N. car, which was standing on the track; and claimed that the handling line was responsible for the damage to the car, as it did not comply with Section d, Item 4 of Rule 32.

The Arbitration Committe rendered the following decision: "The car was not damaged to the extent shown in the foot note to Rule 43; therefore, Item 4, Section d, Rule 32, does not apply. The car owner is responsible."—*Case No.* 1378, *Terminal Railroad Association of St. Louis vs. Louisville & Nashville.*

Car damage as a result of a loose coupler carrier iron

On June 24, 1924, a Bessemer & Lake Erie train of 49 cars and two locomotives, in stopping to enter a siding, ran by a switch. In taking slack to back up to clear the switch, the train broke in two between Gulf, Mobile & Northern car No. 747, a steel underframe, side door ballast type gondola car, and Union Railroad car No. 7163, the eleventh and twelfth cars from the locomotives. The cause of the accident was that the coupler on the U. R. R. car was hanging down because the carrier iron was loose at one end. The engineman, not knowing that the train was broken in two, backed the head end into the rear end of the train, damaging the two cars mentioned above. On July 3, 1924, the G., M. & N. car was reported to the owner for disposition under Rule 120. As the two contending roads could not agree as to the circumstances under which the car was damaged, two joint inspections of the car were made, both of which resulted in disagreements as to the condition of the car before the break-in-two and as to the responsibility for the damage. The B. & L. E. contended that, when built, the car was probably not of the best design for use in heavy train service and that it had the usual corrosion resulting from thirteen years' service, the damage being primarily due to the condition of the car and not to the accident in question. The G., M. & N. complained that owing to the circumstances under which the car was damaged, under Section D, Items 2 and 5, Rule 32, the handling line was responsible and should have reported the car under Rule 112, instead of under Rule 120.

The Arbitration Committee rendered the following decision: "The evidence indicates that the damage did not occur at the time the train broke in two between G., M. & N. car No. 747 and U. R. R. car No. 7163, the eleventh and twelfth cars from the head end. It further shows that the engineman, having run by the switch and with the train broken in two, backed the forward section into the rear section, thereby causing the damage. Such mishandling is the responsibility of the handling line."—*Case No.* 1376, *Bessemer & Lake Erie vs. Gulf, Mobile & Northern.*

Car not properly stenciled when safety valves were tested

The Hocking Valley rendered to the Texas Company its repair card dated June 16, 1924, covering the testing of safety valves on T. C. X. car No. 1300 on account of the car being stenciled "last date 6-13-22 The Texas Company." The car arrived at the Norfolk plant of the Texas Company and the safety valves were tested by the owner on June 4, 1924, on account of the car being stenciled "expired date 6-12-22 The Texas Company N. T." When this fact was noticed by the owner, it was evident that the Hocking Valley had either not applied the proper stenciling or failed to obliterate the old stencil. Accordingly, the owner requested the Hocking Valley for offset authority to cancel the repair charge which was refused.

In a decision rendered by the Arbitration Committee it was stated that "the Hocking Valley evidently failed to remove the old markings and apply new markings in connection with the testing of safety valves. Therefore, their bill should be cancelled."—*Case No.* 1427, *The Texas Company vs. Hocking Valley.*

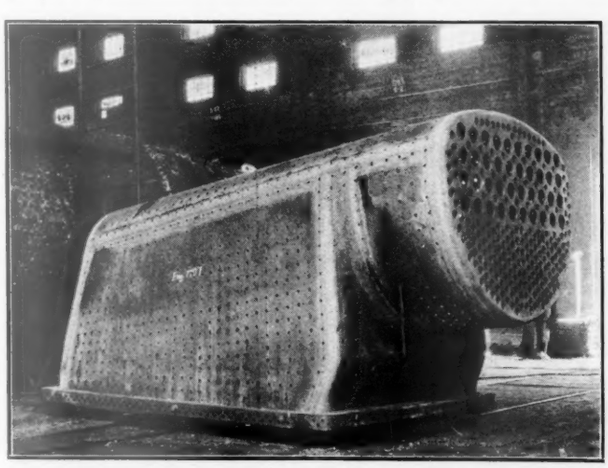
Repairing locomotive parts by the welding processes*

Selection of the correct process, calculating costs and proficient operators important factors

By G. H. Gjertsen

Master welder, Northern Pacific, St. Paul, Minn.

AS it would be impossible to cover the entire field of welding of locomotive parts by the three principal processes, namely, the oxy-acetylene, electric and Thermit, the contents of this paper will be confined as much as possible to the major welding operations and to such other operations as are most common in the general construction and maintenance of locomotives.



Fire box completely oxy-acetylene welded

The choice of method to be used should only be made after due consideration of several factors, such as the kind of metal to be welded, the size and character of the part, the location of the break, whether it is to be welded in place and the cost of doing the work, bearing in mind that the first cost must be considered in the light of the relative qualities of the weld in service. Gas welding, electric welding and Thermit welding each has their advantages in its field and is capable of accomplishing some particular operation better than another method.

A basis for determining the process to be used

In railroad work the Thermit is almost entirely limited to the welding of engine frames, while the oxy-acetylene and electric arc cover much the same field in the welding of many of the steel parts. No definite limit can be placed on the use of any of these processes where either may be used with success. If equal results can be obtained it is, of course, desired to use the process with which the work can be performed most economically and to the best advantage. The general run of castings and parts made of cast iron or brass, bronze, aluminum, etc., (non-ferrous class) are welded with the oxy-acetylene process. In cast iron, many heavy sections, however, such as are sometimes encountered in repairs to shop machinery are successfully welded with the Thermit process. Other heavy cast iron sections such as cannot be properly preheated for either the oxy-acetylene or Thermit process, are repaired by the electric arc process using the usual system of distribution of steel studs about the welded junction.

The welding of heavy cast-iron parts may be accomplished with any one of the three processes, the process selected depending on the outlined conditions. However, generally speaking, where the conditions are favorable for proper preheating and execution of the work, the oxy-acetylene process is preferred in the welding of cast iron parts.

In compiling a list of parts on which fusion welding has become standard practice in the construction and

* A paper read before the Fall Meeting of the American Welding Society, held at Buffalo, N. Y., during the week of November 15, 1926.

maintenance of locomotives, it is only possible, in a limited space, to touch on the major applications and such other applications as are most commonly performed in general routine work in the shops.

The process selected in welding on steel parts where either the oxy-acetylene or electric arc process may be used will no doubt offer much room for discussion.

It must be borne in mind, however, that all operators are not of the highest skilled type and able to do full justice to the process they represent. The proficiency of the operators, whether it be good or bad, whether it be gas, electric or thermit, many times results in the establishing of practices that are not entirely justified, or based on actual results that could be obtained.

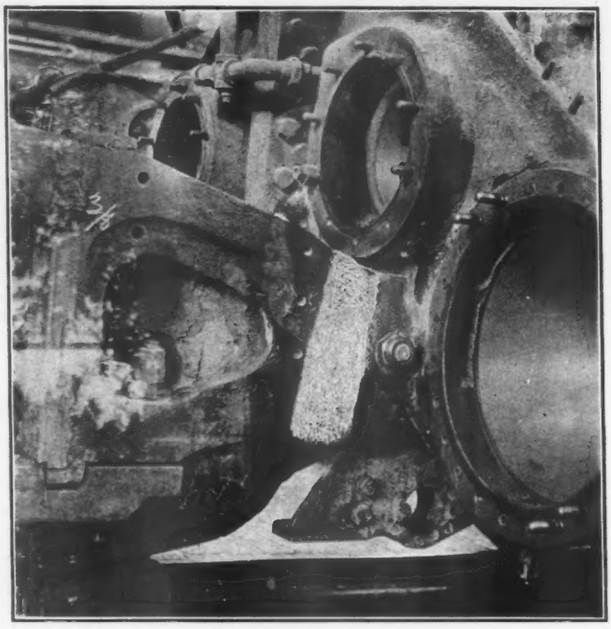
The equipment and facilities with which to perform the work must also be considered, as few railroads are fully or adequately equipped to do their work at all points with all of the three processes to the extent that the lowest figures in economy can be effected. Where equal or satisfactory results can be obtained, the selection of the process to be used should be based on the costs of the application.

Determining welding costs

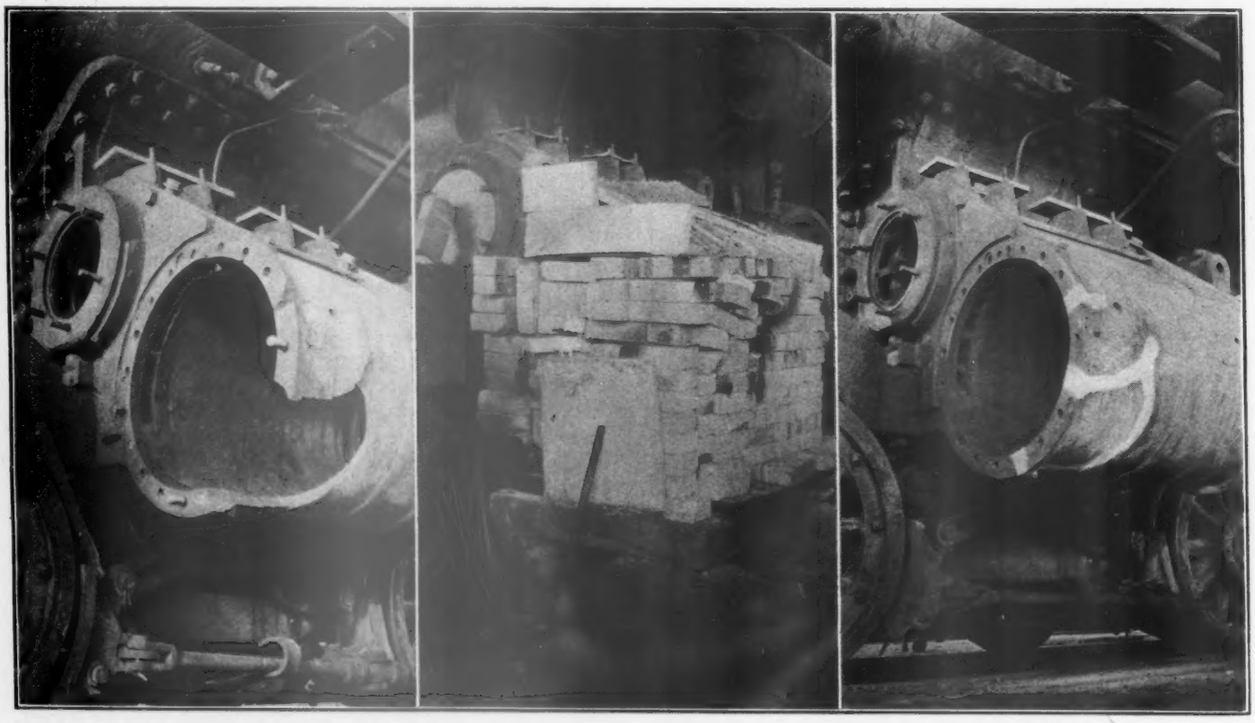
In calculating the economies effected by welding, it is necessary to keep extensive records at least for a sufficient period of time to strike a fair average of the varying conditions under which the work comes in and is executed, as well as from the service rendered. The cost of making gas welds, for instance, can be arrived at by checking the time required to do the work, the quantity of gases, welding rod, etc., used, and the cost of finishing the work after the welding is completed, if further finishing is required.

The cost of making electric welds can be calculated in the same manner, excepting that the electric energy or current used, must be checked instead of the gas which is used with the oxy-acetylene process. The rating of the welding set or tables provided for this purpose may be used in calculating the current used, or this may also be determined by the use of a meter.

With the Thermit welds the time is checked, the weight of materials used, etc. In addition to this, in making welds with any of the three processes, it is, of course, necessary to include the cost of preparing the work, such as cutting out the vee, chipping or sandblasting, preheating and annealing, as well as the necessary dismantling, etc. Scrap value and overhead should be included.



Locomotive frame repaired by the Thermit process



Broken cylinder repaired by gas welding—Center view shows method of preheating—Cost of finished weld, $71—Estimated saving, $691

If, for instance, the repaired job is a casting, it should be given a value rating as compared with a new one, as

all reclaimed material cannot be considered to be of the same value as new.

A few examples of savings effected on some of the major operations may be noted as follows:

No. Part	Total cost new	Total cost to weld, including overhead	Total scrap value	Total saving
6—Driving wheel centers..	$1,500.00	$147.31	$90.00	$1,262.69
6—Locomotive cylinders....	5,300.00	740.13	540.00	4,019.87
6—Engine tender bolsters..	630.00	124.92	67.30	437.78

In order that the success and economy of the various welding applications may be definitely known, careful and complete records must be kept of all the sufficiently important operations.

Those responsible for the application and use of the various welding processes must be in a position to know definitely the results in service, in order that the extending and developing of this work may be handled wisely and to the best advantage.

Bells, injectors, switch stands and jacks successfully repaired by gas welding

Checking and testing operators

While it would be impossible to keep records of the numerous minor operations performed, yet all of the major and important operations, such as firebox work, locomotive cylinders, frames, car work, etc., should, by all means, be recorded. Where stamping is practicable, this may be done, showing the date and name of the place where the weld was made, also the operator's initials or identity.

Failures of welds should be made known to those in charge where the work was performed, and they in turn make it known to the welder who performed the work in order that the cause of the failure may be determined. By carefully following up any work that has not given satisfactory results, all concerned will be more on the alert to improve the work. It will likewise make it possible to determine the success of the practice.

The inspection of welding must necessarily be largely a matter of observation, both of the operator while he is at work and of the appearance of the weld. Other tests, except in the case of pressure vessels, depend upon the destruction of the weld and are, therefore, inapplicable.

A competent welding instructor or supervisor can readily tell whether an operator is qualified or not to perform the work assigned to him, and none but competent operators should be allowed to handle important jobs. The ability of welders assigned to do important work should be further ascertained by sample welds submitted to laboratory tests.

Automatic electric arc welding

In building up driving wheel centers and trailer wheel centers with automatic electric arc welding equipment, the work is handled in a wheel lathe, the wheels revolving as in an ordinary turning operation. Where much of this work is to be done it is advisable to set aside an old wheel lathe for this purpose as the speed of the lathe must be cut down to about three revolutions per hour to handle the largest driving wheel centers successfully. This can, of course, also be accomplished by putting up an extra countershaft or any other speed arrangement so that the lathe can be used for both purposes. The surface travel of the work should be about 9 in. per minute for the best results. When using a 3/16-in. wire a surface speed of 6 in. to 12 in. per minute shoud be used. However, the thickness of the layer of metal put on will vary with the speed. In covering 6 in. per minute the layer of metal put on will be twice the size of that put on at a speed of 12 in. and in using a slower speed there is less chance of breaking the arc where the surface is rough.

Broken driving wheel spokes repaired by the oxy-acetylene process—Cost of welding and finishing, $24.55—Estimated saving, $225.45

The welding wire used in automatic welding is supplied in coils shipped on spools. About 250 lb. of wire is on each spool.

In the type of driving wheels shown in one of the illustrations it will be noticed that they are recessed in the center. The outside surfaces of the face of the wheel are first built up with the automatic equipment. One

operator operates both automatic heads and on 62-in. wheels of this type about five hours are required for the automatic operation where a layer of metal about 3/16-in. thick is put on the surface. The filling in of the bridges is done by hand and requires about three hours on each wheel. Where the wheel has a solid face and can be finished with the automatic, better time can be made.

The illustrations showing the automatic equipment set up for building up guides show one set of equipment complete, which includes one motor-generator set, one control panel and one automatic welding head. The latter is mounted on the carriage of the lathe in such a way that it can be raised and lowered to accommodate the work. This arrangement can be used for any flat work, also for work that is round and can be revolved in the lathe centers or in the chuck.

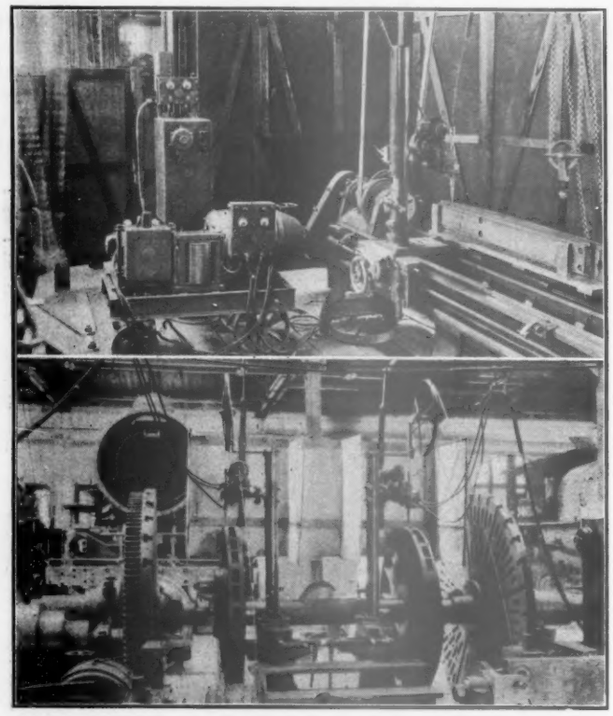
The automatic equipment is very sensitive and cannot be operated successfully from a line where the electric current has too much of a variation in voltage or where there is interference from heavy loads cutting in. A sudden fluctuation of current has a tendency to break the arc when the machine is working to its capacity and interferes with the smoothness of the finished welded product.

Where 3/16-in. wire is used, a current of approximately 250 amp. is required and if a separate motor-generator set is used for each automatic head, it should be of 300 amp. capacity. Each automatic head will deposit from two to three times as much metal per hour as a hand operator and consumes seven to eight kw. per hour.

List of parts covering the most common applications of fusion welding in the construction and maintenance of locomotives

LOCOMOTIVE WORK

Locomotive cylinders	Oxyacetylene process
Firebox work, general	Gas or electric (optional)
Motion work (building up worn surfaces)	Electric
Building up locomotive piston heads (mang. bronze)	Gas
Building up air pump piston heads (mang. bronze)	Gas
Building up locomotive guides	Electric (automatic operation)
Building up steel driving wheel centers (diam.)	Electric (automatic operation)
Building up trailer wheel centers (diam.)	Electric (automatic operation)
Building up steel driving box flanges	Electric (automatic operation)
Welding spokes driving wheel centers (cast iron)	Gas process
Welding spokes trailer wheel centers (cast iron)	Gas process
Welding spokes trailer wheel centers (steel)	Gas or electric
Welding spokes driving wheel centers (steel)	Gas or electric
Building up worn engine truck jaws (cast iron)	Gas
Building up worn engine truck boxes (cast iron)	Gas
Building up broken lugs driving boxes (steel)	Gas or electric



Building up crosshead guides and driving wheel centers by automatic arc welding

Building up broken lugs driving box cellars (cast iron)	Gas
Welding broken engine truck cellars	Gas
Welding broken tank truck cellars	Gas
Welding broken driving box cellars	Gas
Building up worn crossheads	Gas or electric
Building up broken lugs air brake cylinders	Gas
Building up broken lugs air brake reservoirs	Gas
Repairs to injectors and lubricators	Gas
Welding on grates and ashpan slides	Gas
Building up worn brake beams	Gas or electric
Building up worn equalizers	Gas or electric
Welding on steam pipes	Gas
Welding on nozzle stands	Gas
Welding on air compressor cylinders	Gas
Welding and building up on spring saddles	Gas or electric
Welding and building up on engine truck swing links	Gas or electric
Building up lateral main rod brasses	Gas
Welding locomotive frames	Thermit, gas, electric
Welding engine truck frames	Gas or electric
Welding bells	Gas
Building up worn stoker screws	Gas or electric
Welding flues to flue sheet	Electric
Broken mud rings	Gas or electric

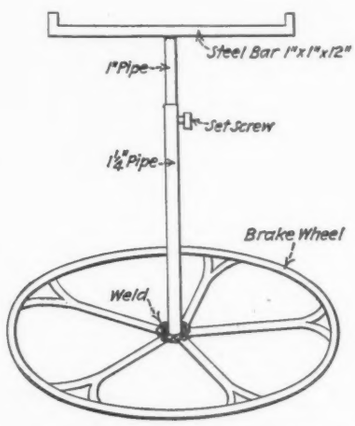
CAR WORK

Bolsters	Gas or electric
Truck sides	Gas or electric
Couplers	Gas or electric
Coupler knuckles	Gas or electric
Axles (end collars)	Gas or electric
Truck pedestals	Gas
Air reservoirs	Gas
Center plates	Gas or electric

An accessory for the blacksmith or pipe shop

By Joseph C. Coyle

A HANDY accessory used in the blacksmith shop of the Denver & Rio Grande Western, Denver, Col., is a movable, adjustable support for holding the free end of bar iron or pipe, the other end of which is being worked on. It is made by welding an 18-in. section of iron pipe to an old brake wheel. A similar section of one-inch round steel slips inside the pipe. This section can be adjusted to any height desired and is held in place with a set screw. A cross piece, 12 in. long of 1-in. by 1¼-in. steel turned up at each end, is welded to the top as shown in the sketch. The ends are turned up to prevent the bar from sliding off.



A portable support for holding one end of long pieces of bar iron or pipe

Lehigh Valley has well organized system shops

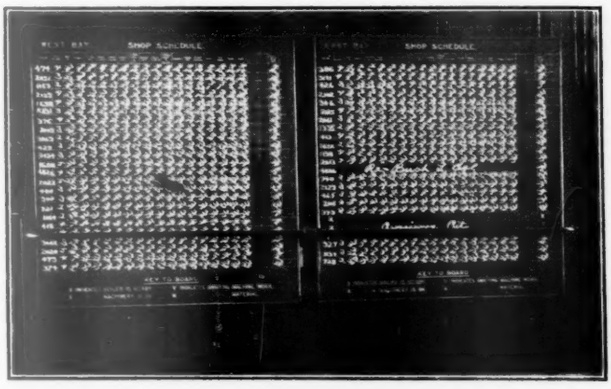
Teamwork among the shop forces is basis of production system—Detail cost records kept

Part II

Delivery truck train leaving the storehouse annex.

GOOD organization and teamwork on the part of the division master mechanics with the various departments, together with a good utilization of available shop facilities, are undoubtedly the outstanding features in the operation of the Lehigh Valley system shops, Sayre, Pa. Sixty days before a locomotive is due for classified repairs, the division master mechanic submits a report to the superintendent of motive power showing the condition of the locomotive at that time and what items will probably be needed when it goes into the shop for classified repairs. This report is then approved, in whole or in part, by the superintendent of motive power who forwards it to the shop superintendent at Sayre.

Upon receipt of the report by the shop superintendent, he in turn notifies the district storekeeper at Sayre. This advance notice on the part of the mechanical department gives the stores department an opportunity to have all



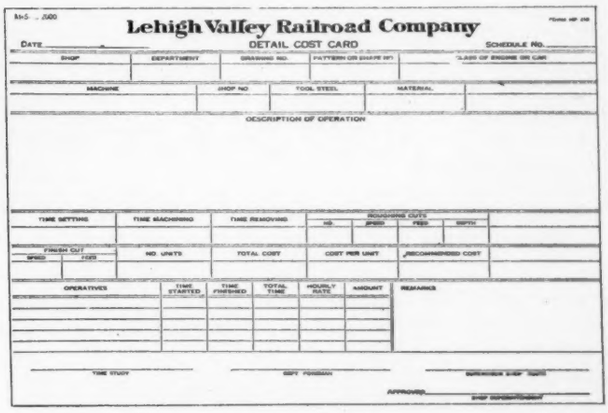
The shop schedule board

the material needed on hand when the locomotive arrives at the shop. Quite often the machine shop also needs some extra time to get a part finished, such as a pair of cylinders, before the locomotive comes in for repairs. Cylinders are machined on a storehouse work order to the machine shop, but are not charged out. If it is found when the locomotive is stripped that the cylinders can be repaired by welding, the new cylinders are returned to the stores department.

The division master mechanic's report is, of course, checked by a general inspection which is made on the locomotive when it arrives at the shop, to determine what class of repairs the locomotive is to get. This general inspection creates a shop order for material. The shop inspection made after the parts have been delivered to the various departments from the lye vat (described in Part I, in the November issue) creates the order for small parts.

The repair schedule for each locomotive is made out after the work of stripping has been completed. A meeting of all foremen is held each afternoon at four o'clock and the date out is set for each department. The district storekeeper or his assistant is present at all foremen's meetings when the schedule of repairs is being planned and effects a liaison between the two departments so that material will be available when needed.

Nothing is permitted to disturb the program of repairs after it has once been scheduled. If a locomotive gets behind schedule, the case is taken up at the foremen's meeting and steps are immediately taken to bring the work up to date. There is one gang for each six pits. Competition is keen between the different gang foremen and their respective gangs. When a locomotive gets



Lehigh Valley Railroad Company

DETAIL COST CARD

Date _____ Schedule No. _____

Shop | Department | Drawing No. | Pattern or Shape No. | Class of Engine or Car

Machine | Shop No. | Tool Steel | Material

Description of Operation

Time Setting | Time Machining | Time Removing | Roughing Cuts: No. | Speed | Feed | Depth

Finish Cut: Speed | Feed | No. Units | Total Cost | Cost per Unit | Recommended Cost

Operatives	Time Started	Time Finished	Total Time	Hourly Rate	Amount	Remarks

Time Study _____ Dept. Foreman _____ Superintendent Shop _____

Approved _____ Shop Superintendent

Card used by the supervisor of shop costs in keeping a record of the detail costs of different operations

behind it is charged up as a "loss" to the gang foreman. The resultant competition keeps the men interested which, of course, is an essential factor in improving production.

The scheduling system

The scheduling system has the combined features of simplicity and effectiveness. Each locomotive is sched-

uled according to what the various inspection reports show. Nine items, namely, frames, brasses and bolts, cylinders, lateral, crossheads, guides, main rods, parallel rods, wheels and tires, together with a list of missing equipment, are reported on by the mechanical inspector who inspects the locomotive upon arrival at the shop. This report is turned in to the general foreman as soon as possible after the arrival of the locomotive at the shop. A yard inspection of the boiler is also made and a report is turned in on the condition of the tubes and flues, back tube sheet, right and left side sheets, door sheet, crown sheets, throat sheet, crown stays, fusible plugs, etc. This report, combined with a report of the internal inspection after the engine has been stripped and the tubes removed, and the report of the general inspection, determines the class of repairs the locomotive is to receive.

Only one form, a duplicate of the shop schedule board, shown in one of the illustrations, is in actual circulation. A copy of this form is provided for all the department and gang foremen and it shows the engine number, class of repairs, the date in, and the scheduled date for completion of the principal items of work to be done on the locomotive. The date out is shown in the last column. The shop schedule form, various inspection forms, report forms, etc., are made up on mimeograph sheets. Forms are also provided for reporting delays in erecting shop operations and delivery of material to the general foreman.

The scheduling department keeps a careful check on the operation of the scheduling system and makes a daily report to the shop superintendent of any discrepancies between the scheduled and the actual days that work is completed. The man in charge of the schedule board watches the progress on each locomotive and makes a check at all times.

The delivery system

The stores department is able to keep in close touch with the progress of repairs, not only through its representative but by knowing the actual progress of the work by comparing to the schedule. The shop inspection creates the orders for small parts which are delivered by trucks operating on a regular schedule which is rigidly adhered to. A description of the system used in the locomotive shops at Sayre was published in the July, 1926, issue of the *Railway Mechanical Engineer*, as part of an article on the general subject of handling material in railroad shops.

Five trucks are used to haul trailers from the storehouse to material stations located at strategic points throughout the locomotive shops, at which the truck train stops for the delivery of material and for the collection of orders for material. A hook is provided at each station on which all orders for material to be delivered to that station are hung, to be collected by the delivery man. The stores department has charge of the trucking system and the scheduling of truck deliveries to all departments.

LEHIGH VALLEY RAILROAD

Mimeo. No.16

REPORT OF MACHINES IDLE

Shop No._____ Date_____19___

SECTION:

Machine No.	Man's Check Number	CAUSE						Remarks
		No Work	No Man	No Jigs	No Tools	Break-down		

CORRECT_____ Foreman (S)_____

This form to be filled out one-half (½) hour after the starting time of each shift by Piecework Inspector, with assistance of Foreman and Forwarded to Schedule Office.

Report showing machines idle and causes for idleness

All heavy castings are handled after the regular working hours so as not to tie up the crane service. Two flat cars, on which all heavy material is transported, are switched daily between the main storehouse and the locomotive shop, one car being spotted at the storehouse and the other at the shop for loading or unloading during the day.

The importance of having adequate crane service at all times during working hours and the need for cooperation in seeing that the time of each crane is used to advantage on the part of all employees is emphasized by the shop management. Each employee having any occasion to use crane service is required to report any delay in obtaining it. A mimeographed report form is provided on which is a space for the employee's name, kind of machine, machine number and department in which the machine is located. This report shows the number of hours worked, time waiting for crane, number of lifts per day, together with any remarks the employee

LEHIGH VALLEY RAILROAD Form No.2

SHOP SCHEDULE

Engine	Class Repairs	Date in	Wheels	Driv Box	Shoes Wedges	Sprg Rigg	Blr. Work	Steam Pipes & Units	Blr. Test	Eng. Whled	St'm Chst & Valv	Guides	Valv Set	Brk Rigg	Rods	Cab Work	Tank	Paint		Date to be Out

Key to Board:
"A" - Indicates Boiler is Ready
"X" - " Machinery is O.K.
"Y" - " Awaiting Machine work
"M" - " Awaiting Material

Shop schedule form—Copies are prepared for all department foremen—It is a duplication of the schedule board

feels may be of use towards providing efficient crane service.

A sub-storehouse in charge of a stores department employee is located in the center of the locomotive shop, where certain small items, such as Lassiter bolts, pipe fittings, washers, nuts, machine bolts and other similar articles, are carried. This plan eliminates the necessity of handling such items in small quantities by the delivery system. A number of small racks are also located at convenient points in the shop where a 15-days' supply of live items, such as are carried in the sub-storehouse, are maintained, enabling the shop men to obtain such items without waste of time. These racks or bins are replenished daily.

The shop order system

Requisitions for finished material are also made on the system shops by the stores department, not only to replenish stock at Sayre, but at other points on the Lehigh Valley as well. These requisitions are forwarded to the Sayre storehouse, and then to the division accountant's office where a shop order is made out and a number assigned. The shop order is sent to the stores department where it is recorded and is then sent via the shop superintendent to the foreman concerned. When the order is completed, the foreman enters the time and material charges on the order form and returns it to the shop superintendent. The storehouse is then notified that the order is completed and is located at a certain material station. The delivery man then notifies the truck driver who collects the material on the next trip and delivers it to the proper department in the storehouse. The order form, with the time and material charges entered thereon, is returned to the division accountant for his information.

The proper time charge is determined from records maintained by the supervisor of shop costs who reports to the shop superintendent. Time studies are used to establish piece rates. These studies, which are being made constantly, consist essentially of checking the same operations by different men on different machines and then taking the average. They are repeated after the foremen and men have had an opportunity to cut the time down. The rate is finally set by the study of the job from records taken by the time study man. Time wasted due to improper organization of the work is considered and is either left out or in, or partly out, according to the circumstances surrounding the work and the nature of the job.

A record is also kept of the utilization of machine tools in each department. This is accomplished by means of a mimeographed report form which is filled out by the piece-work inspector, with the assistance of the depart-

Lehigh Valley Railroad Company

MAINTENANCE OF EQUIPMENT DEPARTMENT

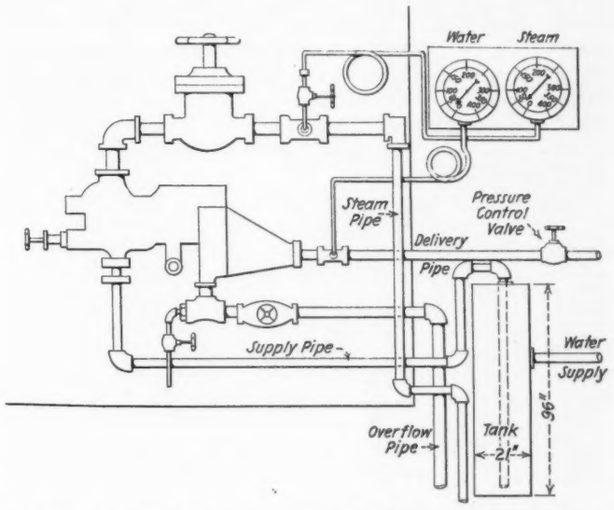
SCHEDULE FOR LOCOMOTIVE REPAIR WORK AT ..... SHOP

Engine No. ..... Class of Repairs ..... Assigned to Foreman .....

OPERATIONS	SCHEDULE DAY	ACTUAL DAY	OPERATIONS	SCHEDULE DAY	ACTUAL DAY
			Continued		
Engine in Shop			Engine Wheeled		
Tank to Tank Shop			Shoes, Wedges and Binders up		
Engine Stripped			Air Pump, Reservoir and Air Cylinders Applied		
Wheels to Machines			Steam and Dry Pipes Complete		
Valves and Pistons to Machine			Superheater Units Applied		
Crossheads and Guides to Machine			Superheater Work Completed		
Eccentric Straps to Machine			Front End and Door on		
Jacket and Lagging removed			Air Reverse Gear Applied		
Final Inspection			Pilot Beam and Pilot Applied		
Parts to Cleaning Vats			Couplers, Levers, Steps, and Grab Irons Applied		
Parts from Vats Delivered			Valves Ready for Engine		
All Material Ordered			Pistons Ready for Engine		
Driving Boxes to Machine			Crossheads Ready for Engine		
Superheater Units Removed			Rods Completed		
Steam Pipes Removed			Eccentric Straps to Floor		
Air Reverse Gear Removed			Stoker Repaired and Applied		
Driving Box Brasses to Machine			Hand Rails up		
Guides ready for Engine			Valves Applied Complete		
Frames, Wheels etc. Cleaned			Pistons Applied Complete		
Flues to Flue Shop			Guides and Crossheads up		
New Parts Delivered to Shop			Ash Pans Completed		
Boiler to Boiler Shop			Grates Applied		
Frame to Smith Shop			Smoke Box Fixtures Complete		
Rods to Smith Shop			Tank Ready		
Tank Forgings to Smith Shop			Motion Work Erected		
Brake Rigging to Smith Shop			Valves Set		
Spring Rigging to Smith Shop			Brake Rigging up		
Tank Forgings to Tank Shop			Rods Applied		
Rods Returned to Rod Shop			Pipe Work Completed		
Brake Rigging to Machine Shop			Lighting Equipment Applied Complete		
Spring Rigging to Machine Shop			Engine Painted		
Frame to Machine Shop			Engine and Tender Cut and Coupled		
Driving Box Brasses Pressed in Box			Engine Fired		
Spring Rigging to Floor			Safety Valves Set		
Brake Rigging to Floor			Air and Steam Heat Completed and Tested		
Shoes and Wedges Laid out and Sent to Machine			Engine Broken in or Whiteleaded		
Frame Binders Closed					
Frame to Engine					
Frames Applied					
Boiler Returned to Erecting Shop					
Cab Work Complete and Ready for Test					
Flues Applied to Boiler					
Firebox Work Completed					
Boiler Ready for Hydrostatic Test					
Frames Bolted Complete					
Engine Truck and Trailer Completed					
Booster Work Completed					
Wheels Ready for Engine					
Driving Boxes Ready for Engine					
Rocker Boxes Refitted					
Shoes and Wedges Passed to Mach.					
Frame Binders Refitted					
Spring Rigging Applied					
Boiler Lagged					
Jacket Applied					
Cylinder Work Completed					
Tank Cistern Completed					
Running Boards up					
Cab on and Floor Applied					

SCHEDULING DEPARTMENT

Form of report made by the scheduling department showing actual progress of work compared with scheduled progress



Sketch showing the arrangement of the injector test rack

Interior view of valve repair department showing the air brake test rack

ment foreman, and forwarded to the schedule office. This report shows the number of the machine, the operator's check number and the causes of the machine being idle. This report is signed by the piecework inspector and checked by the department foreman.

Locomotive shop maintains good production

The locomotive department employs approximately 850 men, which includes those employed in the blacksmith shop, power house and those employed as supervisors. It has an output of one locomotive every 4½ shop hours in addition to the large amount of manufacturing work it performs for the entire system. About 400 men are employed in the erecting department which is divided into two bays, one on each side of the building.

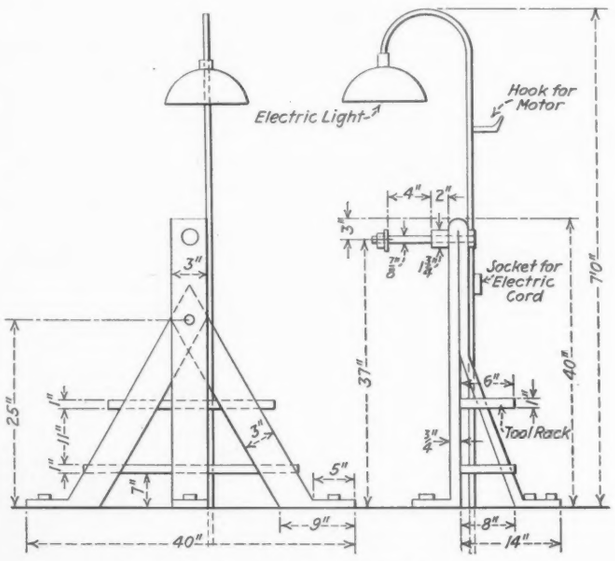
Adequate facilities, a description of which was included in Part I, are provided for handling the work in the erecting shop. Efficient crane service permits the prompt moving of parts to and from the lye vats and the handling of lubricators, injectors, etc., to the proper department for repairing and testing. All work of this nature, including air brake valves, steam and air gages, safety valves, etc., is performed in one department located at the southeast end of the machine shop. The locations of the various machine tools, test racks, special benches, etc., are shown in the drawing of the floor plan of the locomotive shop included in Part I.

The air brake test rack, shown in one of the illustrations, is designed to test all locomotive air brake equipment in strict accordance with the Westinghouse code. Tests are provided for H-6 brake valves, independent brake valves, distributing valves, G-6 brake valves, plain triple valves, brake pipe vent valves, auxiliary device governors, bell ringers, feed valves, signal valves and signal equipment. A rigid test is provided for all slide valves, graduating valves and piston ring leakages, also the frictional resistance of equalizing pistons is registered. The section of the test rack provided for feed valves is so constructed that three valves may be tested simultaneously. The other part of the rack is arranged so that each appliance can be completely tested independent of all other devices; or the equipment of the entire test rack may be operated and tested as a unit, by operating certain by-pass valves.

Looking down the machine shop bay from the rod department

Westinghouse charts of the ET equipment and printed copies of the Westinghouse test codes for the brake and signal equipment are located on the back of the test rack as a guide for the operator. The air used for operating the test rack is supplied from the shop air line through a booster pump located at one end of the rack which assures an adequate supply of air at all times. An Eastman timer is provided for timing purposes in testing the different appliances.

Special equipment is provided for repairing and testing injectors. The repair rack, shown in the sketch, is constructed of 3-in. by ¾-in. iron bar. Two racks are provided for tools and also a hook on which to hang the air motor used for reaming, etc. The ⅞-in. bolt is inserted through the bolt hole in the body of the injector provided for securing the injector to the boiler. The injector can be clamped in any convenient position by merely tightening the nut on the bolt. This rack is suitable for practically all types of locomotive injectors commonly used.



Sketch of the injector repair rack

The use of the injector test rack, also shown in one of the sketches, eliminates considerable time and trouble in having to wait for the locomotive to be fired up. Referring to the sketch, it will be noted that the conditions for tests are practically the same as those met with in actual service. The supply pipe leads from an open tank and the water is delivered against pressure which is regulated by a control valve. Gages are provided for ascertaining the pressure of the water in the delivery pipe and also for ascertaining the steam pressure used in creating the water pressure in the delivery pipe. If the water pressure exceeds that of the steam pressure by a certain amount, the injector is marked O.K. for service. Both the repair and test racks were developed by members of the Sayre shops organization.

The machine shop

The various departments of the machine shop are arranged in logical order through the center of the locomotive shop building according to the character of work performed. A drawing of the floor plan of the locomotive shop showing the location of the machine tools

and shop equipment, together with a list of the equipment, was included in Part I. Approximately 300 men are employed in the various departments of the machine shop a portion of whose time is devoted also to manufacturing work. The entire machine shop is in charge of the general machine shop foreman, with one machine foreman assigned to each side.

An automatic turret lathe department located adjacent to the valve repair department produces finished parts in quantity for stock, such as, studs, taper pins and bolts, valve spiders, small bushings, journals, grease cups, etc. Many of the parts produced in this department are used by the valve repair department in the repairing of air brake valves, etc.

The utilization of automatic and semi-automatic machine tools is a considerable factor in obtaining efficient utilization of man power. One man for example, performs the work of drilling pistons and crossheads, and also operates an automatic machine for milling keyways in crossheads and piston rods. Another case is that of one man being assigned to two lathes, one for finishing wrist pins and the other for finishing piston rods.

The wheel shop is provided with two vertical boring mills; namely, an 84-in. and 72-in., both of which are motor driven, for turning tires and wheel centers. One mechanic and a helper removes all driving wheel and trailer tires, turns and shrinks them on the wheel centers. It is also the practice to keep an extra pair of booster wheels on hand at all times to apply when needed.

Shoes and wedges are planed to line, driving boxes paralleled aand crossheads are planed on a 32-in. planer. Crank pins are turned and finished on a 36-in. lathe equipped with a shop-made turret that holds four tools, a roughing tool, a finishing tool, an end tool and a roller. Cylinders are planed on a 72-in. planer, no chipping is done in finishing a cylinder casting.

The boiler shop

The boiler shop is located in the end of the locomotive shop building opposite to that in which the valve repair department is located. Approximately 100 men are employed in this department. The location of the boiler repair work at one end of the building facilitates the routing of the work by crane direct to and from both erecting shops. A separate department is maintained for the repair of superheater units, the location of which is shown in the floor plan drawing of the locomotive shop included in Part I. The boiler shop also has its individual tool room which issues and maintains all the small tools incidental to boiler repair work, such as air motors, riveters, staybolt taps, etc. A 15-ton hydraulic gap riveter greatly facilitates the work of riveting seams in the barrel of a boiler. This riveter is located so that it can be served by an overhead travelling crane, which is used for up-ending the boiler and holding it in the riveter.

The work of tapping staybolt holes in fireboxes is speeded up considerably by having two men work together, one inside the firebox and the other on the outside. Instead of reversing a tap and backing it out of the hole, the tap is run entirely through the hole, and is taken by the man on the opposite side and returned through another hole in the same manner. With this system, two taps and two air motors are kept in practically constant operation and no time is lost in backing out the long taps. An unusually high standard of workmanship is maintained in the boiler repair work, not only in riveting joints, but also in welding.

Flues are removed from a boiler and taken to the flue shop by crane and truck—An outlet for acetylene welding is shown at the left

Welders are required to make six test pieces every three months. These are sent to Packerton, Pa., for test. If these test specimens do not meet requirements, the welder is given further instruction and is only permitted to do certain kinds of work until he qualifies. Test pieces are made from ⅜-in. or ½-in. boiler plate and the weld must withstand a tensile stress of at least 75 per cent better than the allowable tensile stress for the plate itself. This method of examination of the welders has resulted in a high standard of workmanship. Out of a recent lot of 50 test pieces, 47 welds were as uniform as

Interior view of the flue shop

the plate itself, while three were under the required tensile stress.

The flue shop

The flue shop is in a separate building 62 ft. wide by 182 ft. long, and is located southwest of the assembly hall. This location makes it comparatively easy of access not only from the locomotive shop, but from the enginehouse as well. Flues are handled by rail truck from the locomotive shop to the flue shop and back. The layout of track for both the locomotive shop and enginehouse permits the flue truck to be easily moved.

The flue shop is well equipped to handle the flue work for both the locomotive shop and enginehouse. The following is a list of the equipment used in the flue shop:

1 18-in. lathe.
1 Electric flue welder.
1 Butt flue welder.
2 Flue testers.
1 Turret lathe.
5 Flue cutters.
4 Air operated flue hammers.
2 Flue swedges.
2 Flue rattlers.
1 Flue roller.

Conclusion

One of the outstanding features in the operation of the locomotive shops at Sayre is the method of handling the

Display board showing the various kinds of production jobs that are handled in the blacksmith shop

work in the blacksmith shop. About 60 men are employed in this shop and it is well equipped with machine tools, etc., for handling a large volume of manufacturing work for the entire system. Examples of various locomotive and car parts manufactured in the blacksmith shop at Sayre are shown in one of the illustrations. Lack of space prohibits the inclusion of a description of the detail operation of the blacksmith shop in this article. A separate article describing the many shop kinks and practices used in the blacksmith shop is contemplated for a future issue.

The spirit of co-operation on the part of the men has resulted in many improvements in shop practices that have been a considerable factor in obtaining better production. Practically every man in the shop organization seems to be doing his best to turn out more and better work on his particular job. Many jigs and fixtures not described in this article because of lack of space were originated by the men. Some of these will be described in the future.

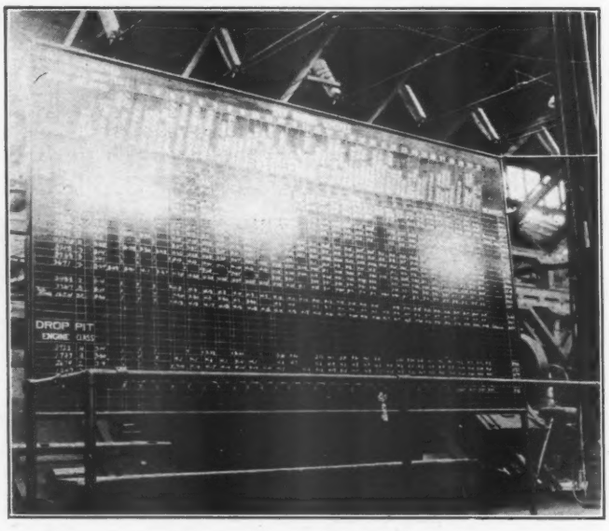
As stated in the introductory paragraphs of Part I, published in the November issue, a large share of the credit for the introduction of the personnel methods not only in the locomotive shops at Sayre, but on the entire Lehigh Valley system as well, belongs to President Loomis. Of course, little could have been accomplished without the earnest co-operation of all the supervisory officers and employees, and to whom a great deal of credit is due for the tactful handling of the initial steps in the starting of the personnel methods as they are in operation today at the Sayre system shops of the Lehigh Valley Railroad.

Master schedule board at Sacramento

By Charles W. Geiger

AN interesting feature of the locomotive repair shops of the Southern Pacific, Sacramento, Cal., is the construction and type of the master schedule board, which fills an important function in the scheduling system. The board is located in the erecting shop, central to the other departments, and is mounted on a frame made of pipe, as shown in the illustration. A hand rail is placed around the front to protect the marking on the board. Provision has been made to see that the board is well lighted both day and night.

The schedule dates for all work to be done are shown on the master schedule board as soon as the engine is shopped. In addition to this board, department schedule



The master schedule board of the locomotive shops of the Southern Pacific, Sacramento, Cal.

boards have been placed in the general foreman's office, boiler, tank, blacksmith and machine shops and other departments which are concerned with locomotive repairs. These department schedule boards are of considerable assistance to the foremen as it makes it unnecessary for them to leave their departments to see how their work is coming along or to hurry the foremen of other departments for material. The schedule dates when once set are not changed and it is necessary for each department to have its work completed and ready for the locomotive repair shop on the day indicated on the schedule board.

Dependable method of setting Walschaert valve gear

Simplified by predetermining and maintaining the proper lengths of the various rods

By L. V. Mallory
Gang foreman, Missouri Pacific, Kansas City, Mo.

THERE are many methods of setting the valves of locomotives using the Walschaert valve gear, and in practically all, the changes required are determined from the tram mark readings on the valve stem. Usually, by these methods, the lengths of either or both the radius and eccentric rods are altered to equalize the valve travel. In a great many cases, the radius rod length is changed without considering the fact that it should have but one length to insure that the valve will have equalized travel at all points on the reverse lever quadrant. In many cases, no doubt, the reader can recall where a locomotive would tram square

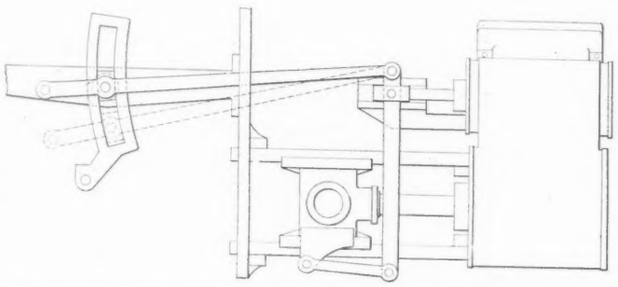


Fig. 1—First step in checking the radius rod for its correct length

at the position the reverse lever was setting when the valves were set and yet would be out when working on an increased or decreased valve travel.

The name radius rod should suggest the reason for this. By asking this question, "Does the center to center length of the radius rod maintain a true radius with the link curvature when changed to obtain the apparently correct valve stem reading?" will bring home the importance of maintaining the correct lengths for radius rods.

In the following paragraphs will be outlined a method of setting the Walschaert valve gear wherein the radius rod, the union link and valve stem lengths are predetermined, leaving only the crank arm location and eccentric rod length to be determined at the final "runover."

Determining the correct length of the radius rod

By referring to Fig. 1, it will be noted that the crosshead, union link, combination lever, valve stem and radius rod are all connected in their regular manner, leaving the eccentric rod disconnected at the link. The correct length of the radius rod may be determined after the cross head has been placed near the center of its travel.

By passing the radius rod from the top of the link downward past the center, the valve will move to a position (if the radius rod is of the correct length) which will form a true center for the link radius when the link is in its central or neutral position. By securing the valve stem in this position and passing the radius rod down to the bottom of the link slot, will hold the link in its neutral position.

To determine the correct length of the radius rod, lock the link, as shown in Fig. 2, in the position it is now held. A pair of small jacks similar to those used in laying off shoes and wedges may be used for blocking the link by placing them between the link and guide yoke. With the valve stem still locked, disconnect the union link from the combination lever leaving the latter free to swing. Now with a small tram, swinging from the center of the front radius bar pin, scribe a line on the valve stem gland, then swing the radius rod upward to the top of the link slot and again scribe a mark with the same tram. If the radius rod is of the correct length, the tram will trace the same line made while at the bottom of the link. Should this second mark fall behind the first one, it indicates that the radius rod is too short and should be lengthened one half the distance

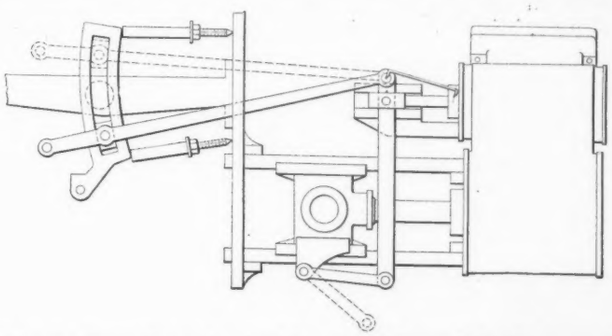


Fig. 2—Second step in checking the radius rod for its correct length

between these two lines. If the second line falls ahead of the first, it indicates that the radius rod is too long and should be shortened one half the distance between the two lines.

After correcting the radius rod, if necessary, to the proper length, place it at the exact center of the link, release the locked valve stem and proceed to take the port opening marks in the usual manner, moving the valve as desired by swinging the free end of the combination lever. Accurately divide the distance between the port marks and make a central mark, after which move the valve with the combination lever until the port mark tram falls in this center line and then lock the valve in this position. This step is shown in Fig. 3.

How to determine the union link and valve stem lengths

The next step is to determine the union link and valve stem lengths. This is done by dividing accurately

for a central mark *C*, Fig. 4, between the striking points on the main guides. The crosshead is then placed on the central mark *C* and the distance between the lower combination lever pin center and the crosshead plate pin center is measured. The union link should be corrected to this length, providing, of course, that the position of the combination lever is not too far from the vertical, which indicates that the valve stem is too long or too short.

As there is usually about a 13 to 1 ratio between the path of the valve stem and union link connecting pins of the combination lever, a divergence of ½-in. either way from the vertical as concerns the combination lever, when measured at the bottom hole, could be made with-

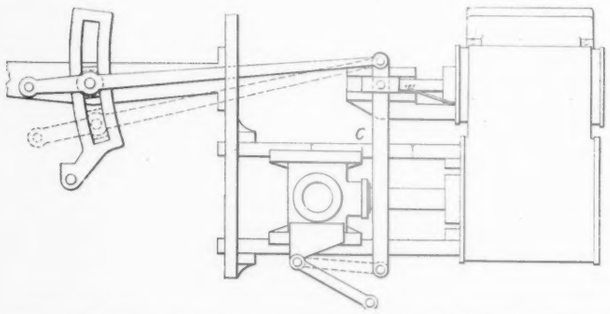


Fig. 3—Taking the port marks and determining the correct length of the union link

out any bad results. This gives a 1-in. margin to work in as concerns the union link before an alteration of the valve stem length should be resorted to. For example, a 1/32-in. change in the valve stem would avoid a 13/32-in. change in the union link. But as it usually calls for the removal of the valve to make a valve stem change, it is more practical to make the correction in the union link as long as the valve stem does not vary over 1/16 in. from the standard length.

Assuming that the union link and the valve stem have now been corrected so that the union link will readily connect with the crosshead and combination lever while the crosshead and valve are still in the same positions shown in Fig. 3, we are now ready to locate the link dead line or neutral mark on the cylinder jacket which will simplify matters in determining the change required in the eccentric rod when the locomotive is "run over."

This is done by simply dropping the radius rod from the center of the link, as shown in Fig. 3, to the bottom of the link, Fig. 4. The pin is placed so that it connects the eccentric rod with the link in its hole with the head out. This affords a center from which to tram, using a tram of sufficient length to reach a point near the center of the cylinder jacket. A vertical line *O*,

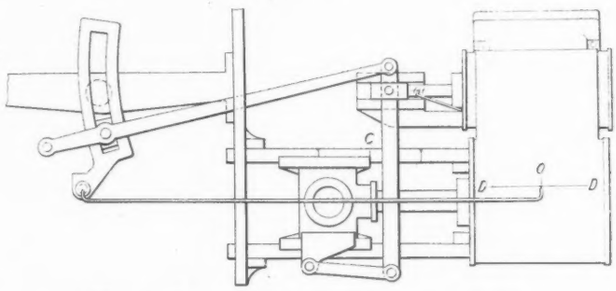


Fig. 4—Locating the link dead center mark

Fig. 4, is scribed in such a manner that it will be bisected by the line *DD* which is scribed on the cylinder jacket parallel with the piston rod and at a distance above the piston center so that the link foot pin is located above the piston center line *C*. The crosshead, main road, eccentric rod and the link and crank arm can now be connected, the valve stem crosshead, of course, being released. We are ready for the final valve "run over" which will determine the length of the eccentric rod and the location of the eccentric crank arm.

The final valve "run over"

In the procedure of running the engine over a live engine or a transfer cable is used to move the engine continuously but slowly forward. While the engine is being moved, one end of the same tram that was used in locating the dead mark in Fig. 4 is hooked in the link-leg pin center and its scribing end is just above the line *DD* on the cylinder jacket, as shown in Fig. 5. The scribing end is allowed to travel along in this manner for a little over one full revolution of the crank pin. This determines accurately the crank arm pin throw. Compare the length of this line thus scribed with that of the throw required in the builder's specifications. Of

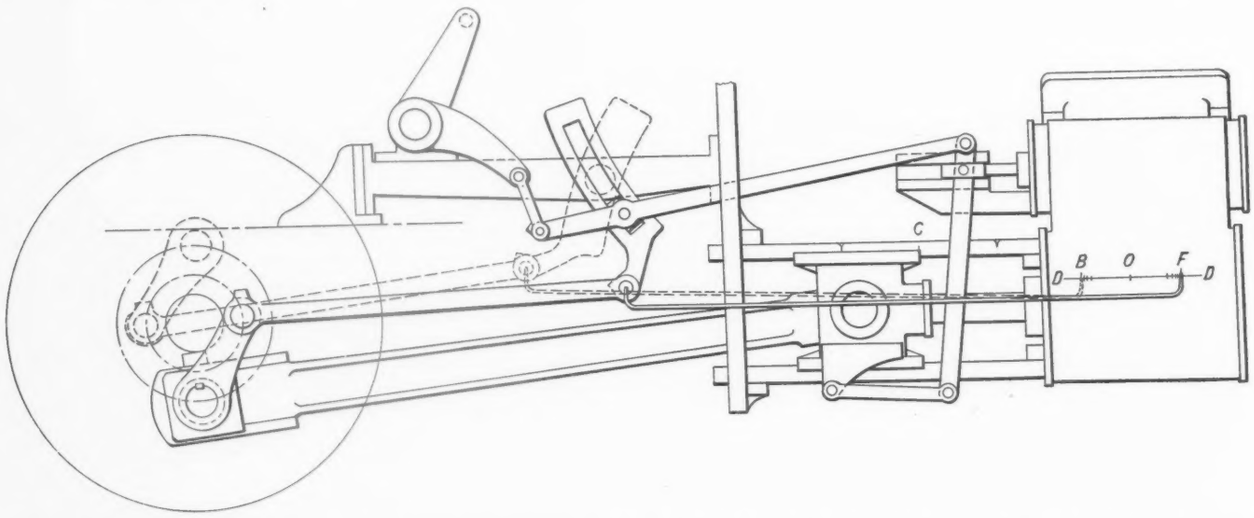


Fig. 5—Running the engine over to determine the correct location of the crank arm and correct length of eccentric rod

course, the center to center length of the crank arm must check up accurately with the standard blue print when using this method. If they agree, it indicates that the eccentric crank arm is correctly located on the main pin.

If the line scribed by the tram is longer than the required throw, it indicates that the crank arm pin is too far out from the center of the axle and should be swung toward the center until it gives the required travel. If this eccentric throw line is shorter than the required throw, it indicates that the crank arm pin is too close to center of the axle and should be swung out to correct the error.

For example, the required throw for the locomotive is 18½ in. and the scribed line measures 18¾ in. To correct, it is necessary to swing the crank arm toward the center, one half the difference between 18¾ in. and 18½ in., which would be ⅛ in. If the keyways of the crank pin and crank arm don't line up with each other when thus corrected, the key must be offset to suit.

If the crank arm location checks up correctly the correct length for the eccentric rod can be readily determined by finding the exact center of the throw line, scribed by the tram when the engine was "run over," and compare it with the dead line *O*. If the eccentric rod is correct in length, the center of the throw line will fall in the dead line *O*. If too long, it will fall ahead and must be shortened the actual amount it falls ahead of the dead mark *O*. If too short, the throw line center will fall behind the dead mark *O* and must be lengthened in the same manner to correct the error.

If the crank arm location is found to be incorrect, it must be corrected and a new throw line scribed before determining the length of the eccentric rod. This calls for pulling the engine over another revolution. To some of the readers, it will appear that by placing the crosshead exactly midway of its travel, the angularity of the main rod has not been considered and also that by dividing the throw line for the exact center, the angularity of the eccentric rod also has been ignored. But if they will consider the fact that the only time the crosshead has any important relation with the valve, through the combination lever, is when it is at either end of its travel, when the lead opening is imparted to the valve, it thus can be seen that the main rod angularity of the Walschaert valve gear is not as important as in the case of other valve gears. The eccentric rod angularity is overcome by back setting the link foot pin. As long as the links are carefully maintained to blue print measurements no trouble will be experienced from this source.

The link block hanger lengths may be predetermined in the usual manner when using this method, but it need not delay running the engine over as it is immaterial in what position the reverse lever is when using this method as the only time the valve stem reading is considered is when determining the union link length.

This method has the advantages of eliminating the labor of pinching engines over centers, avoiding the confusion in calculating ratios, often experienced when making changes suggested by valve stem readings, and also familiarizing the machinist with the functions of the different parts of the valve gear.

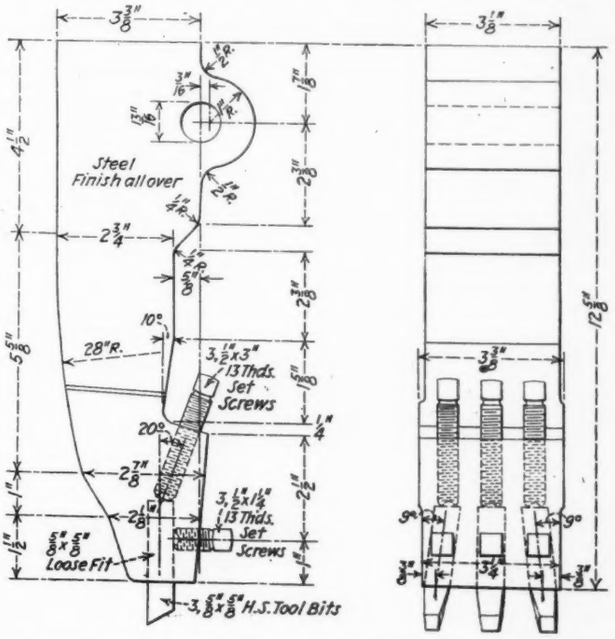
TEXAS & PACIFIC.—A contract has been awarded to the Ware Company, El Paso, Tex., for the construction of a 16-stall roundhouse, steel frame erecting machine shop, blacksmith and boiler shops, brick power house, brick storeroom and office building and several minor structures at Gouldsboro, La., estimated to cost $300,000.

Planing a large main rod brass

By H. H. Henson
Machine shop foreman, Southern, Chattanooga, Tenn.

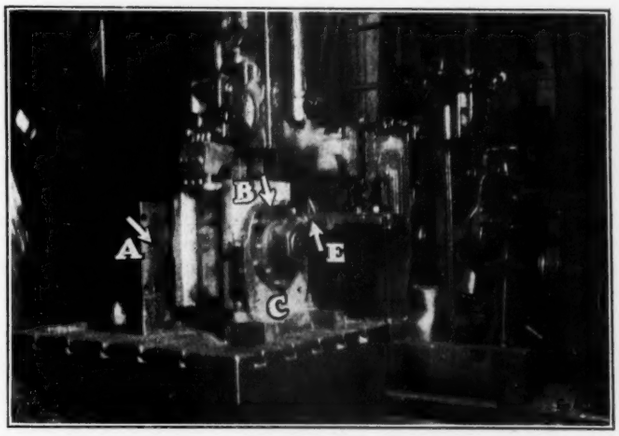
THE accompanying illustration shows how a large back end main rod brass is planed with a gang tool in one hour, using a Morton draw-cut shaper to operate the tool.

The brass is fastened in a swivel chuck *A*. This chuck is easily constructed as it is made of an ordinary angle



The design of the gang tool for planing main rod brasses

plate that has eight spaces equally divided and slots cut for a dowel key to hold the brass at every ¼ and ⅛ position. The chuck is secured to the shaper table by means of bolts and a key fitted to the slot in the table of the shaper and the angle plate. This key insures the proper alinement of the angle plate to the shaper ram.



The gang tool and brass in place on a shaper

The collar on the end of the mandrel is tightened by a large hexagon nut after which set screws in the collar are tightened to secure the brass so that it will not move. The steady rest *C* is placed under the collar *B* and fastened to the shaper table with bolts. The sup-

port *E* is then placed in position between the brass and the shaper which gives the brass a firm support.

Particular care must be taken in grinding the cutters and setting up the shaper. The tool is placed in the clapper box or the tool post head of the shaper after the regular tool post has been removed. The production of this tool depends on the will of the operator to keep it in working condition.

One method of laying off shoes and wedges

By W. H. Ohnesorge
General foreman, Boston & Maine, Mechanicville, N. Y.

THERE is scarcely a shop or enginehouse in the country today that is not confronted with the problem of cut driving and trailer tire flanges. Cut flanges, or those worn to the condemning limit of thickness or worn vertical, are caused by the wheels not running perfectly square or at right angles to the frame.

Many shops, in laying out their shoes and wedges, use strings through the centers of the cylinders extending to the rear of the locomotive frames. A straight edge is then placed against the shoe side of the main pedestal jaws, and a straight edge squared to the cylinder lines. If the straight edge, when placed against the jaw faces, does not show a right angle, the straight edge is moved far enough from the jaw face on one side to divide up the difference, after which the main, or initial starting point in laying out shoes and wedges is marked off on the frame by placing a square on top of the frame and with the blade of the square against the straight edge, a line is drawn on both frames.

There are a number of factors that must be considered in getting the main centers when using this method. The lines through the cylinders are centered with a pair of inside calipers measuring from the cylinder head counterbore in front of the cylinder to the line, and from the piston gland stuffing box in the rear cylinder head to the line.

Unless the mechanic is very accurate in centering the lines, they will not be parallel with the frames. He must use a good linen or silk line and the caliper leg should touch the line just so it can be felt with the calipers. Otherwise, if he calipers a little heavier on one side of the line than on the other, his line will vary greatly, depending on the length of the frames.

When the mechanic moves his straight edge away from the jaw face in order to square it with the cylinder line, he creates the first error towards cut flanges. The position of the straight edge, after squaring it with the cylinder line, is to be the position or angle at which the driving wheels will be set when under the locomotive, or, in other words, the wheels on one side of the locomotive will be running ahead of the wheels on the opposite side, with the result that the side running behind will have the flanges rubbing the rails, which causes cut flanges.

After such a locomotive has run 1,000 miles, the inspector reports flanges cutting on one side. The enginehouse foreman is then compelled to pull down all the shoes and wedges on one side and either line all the shoes to throw the drivers back onto the side not cutting, or plane off on the shoes on the side having the cut flanges. After making the changes, the drivers are then running square with the frames instead of parallel with the cylinders.

The writer is a firm believer in the fishtail tram method of getting the main centers from which to work. By placing a stick between the frames just back of the cylinders and measuring the exact center between them, then marking this center on the stick, the machinist has the first center from which to work. He then uses a tram rod having one tram point which is adjustable. The end of the tram rod has a pointed end which is inserted in the center on the board between the frames. The adjustable tram point is then used to scribe a line either inside or outside on the frame legs at some point near the main jaws. The marks scribed on the inside or outside of the frames should be made on the jaws on each frame without altering the distance between the tram point and the end of the rod, so that each line scribed will be the same distance from the center just back of the cylinders.

If, on account of the frame spreader castings or braces interfering so that the main centers cannot be reached, this line can be scribed on any of the jaws and the line transferred back to the main jaws with the tram rod.

If the lines are scribed on the inside of the frame jaws, a straight edge is used for transferring the lines to the outside of the frame, setting the straight edge at an equal distance from both the marks. Then with a tee-square over the frame and the blade against the straight edge, the line can be drawn on the upper part of the frame at the jaws, for the initial point to work from. The cylinder line can be used to determine if the spreader castings are holding the frames parallel throughout their length, measuring from the cylinder line to each jaw. If the frames are buckled, they should be pulled together or spread at different points to bring them parallel with the lines. If the frame does not measure the same distance from the lines to the frame jaws and the frames cannot be drawn in or out to make them parallel, an allowance should be made for lateral thickness on each box jaw where the variation occurs so as to keep the wheels in proper alinement. By doing this excessive friction on the lateral faces of the driving boxes will be prevented. Allowances should also be made for variations in the thickness of the hubs.

Cylinder lines should not be used in getting the main centers to work from in laying out shoes and wedges. Where the trailer wheels are held in position in the frame jaws, the center of the jaws should be trammed from the center of the back driving box centers so that the trailer wheel centers will be the same distance from the rear driver wheel centers on both sides.

With care taken in laying off shoes and wedges by the fishtail tram method, driving wheel tires will be condemned on acount of tread wear, but not on account of cut flanges and the enginehouse repair men will not be required to pull down the shoes and wedges to throw the drivers ahead or back to make them run square with the frames.

Driving boxes should always be bored central, or the bore of the brass should be an equal distance from the shoe and wedge faces. The rod should be trammed to blue print length, using the centers in each rod. If the rods do not tram up correctly or correspond to the length shown on the blue print, they should be altered so that when the rod bushings are pressed into the rods, the lengths will be correct.

After the wheels and the shoes and wedges are in position under the locomotive, the wheels should be trammed from one center to the other to determine if any errors have been made when the shoes and wedges were laid off. If the distance between the centers varies over 1/64-in., the shoes and wedges should be lined ahead or back so as to bring all wheel centers in tram. Never change the rod lengths to compare with the centers between the drivers. Change the shoes and wedges.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Question–Straightening long reamers

NEW YORK.

TO THE EDITOR:

After the toolroom has completed the machine work on reamers, they are sent to the blacksmith shop for hardening. These tools, which are made from axle steel, are hardened by packing them in carbonizing material, heated for eight hours at 1,550 deg. F. and then left to cool overnight in the packing pot. They are again repacked in the same material, heated to 1,550 deg. F., held at this temperature for seven hours, and then removed and quenched in salt water. They are then heated to 400 deg. F. in an oil vat, where they remain for four hours.

Ordinarily, no trouble is experienced with small reamers, but when working with reamers ranging in length from 12 in. to 27 in. and in diameter from 1¼ in. to 1⅝ in., considerable trouble arises from warping. It is then necessary to straighten them. Our practice has been to heat them slightly and then attempt to straighten them. This method has not been very successful. I would be glad to read of the practices followed by those who have been successful in straightening long reamers.

A BLACKSMITH FOREMAN.

Axle failures in cold weather—A question

CLEVELAND, Ohio.

TO THE EDITOR:

Mr. Litchfield states in his article on axle failures in cold weather published in the August issue of the *Railway Mechanical Engineer*, that "There is no such thing as crystallization of steel caused by long continued service." He then explains that the failures may be attributed to "fatigue" or "cleavage."

I would be very much interested in knowing the nature of this cleavage. Does an actual crack develop gradually which can be detected by white lead or is the trouble microscopic? In either case will annealing restore the original condition?

This question is often raised in regard to rod failures. We continue to anneal drawbars and other parts to "restore their life." Is this beneficial?

JOHN E. KLOSS.

The Answer

NEW YORK, N. Y.

In replying to your question I would say that the nature of cleavage in axles which have failed from repeated strains is an actual crack which develops gradually and which occasionally can be detected by examination of the surface with a high-powered magnifying glass. Ordinarily, however, the crack is not so discernible but it can be made to show up by soaking the axle in oil for some time, then wiping the surface clean and coating over with whiting and finally giving the axle a sharp blow with a heavy sledge hammer. As a result of this hammer blow the oil which has gradually worked its way into the crack will ooze out to the surface showing a distinct hairline in the whiting. The same character of failure has often been observed on other parts besides axles and as the failure ordinarily is a well defined gradual crack, I do not see that there is anything to be gained in such cases by annealing the parts at intervals during service.

NORMAN LITCHFIELD.

Carry on

TO THE EDITOR: MINDEN, La.

There's romance in a railroad job
To one with eyes to see,
With heart and mind anent the work,
What e'er that work may be.
To watch the clock hands 'round the dial,
One's peace of mind despoils
And proves the adage oft retold:
"A watched pot never boils!"

The importance of the work you do
May look like thirty cents.
Yet, any job's worth doing right,
On a Pullman or a fence.
'Tis true, anon someone gets by
Sans sweat upon his brow.
He fools no one, except himself—
That's easy anyhow.

The biggest engine on the road
Would never move our trains,
No matter what her tractive force,
If uncontrolled by brains.
No single mind could turn the trick,
Your job, however small,
Neglected, were perhaps the one
To make that engine stall!

Just think the job you have at hand
Is worth the doing well.
If a line be drawn, hew to that line,
Let chips lie where they fell.
A railroad ladder has no top
Nor fixed rule how to climb.
Things, big or small, must be well done
If trains are run on time.

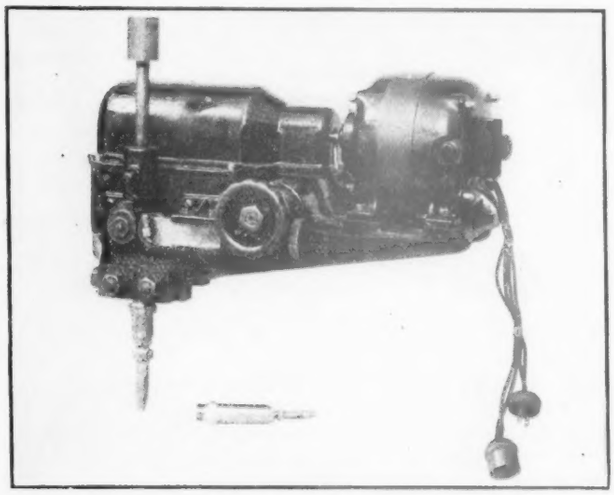
To be a college man or not,
Won't keep one out of ruts.
No job is ever out of reach
Of the man who buts no buts.
Nor does one ever get as big
As being the whole show.
Success, for him, lies in the goods
Delivered from below.

J. B. SEARLES.

Automatic arc welding head

AN AUTOMATIC arc welder, designed to weld with smoothness, speed and accuracy, has been introduced by the General Electric Company, Schenectady, N. Y. With this equipment, the operator pushes a button to start the sequence of operations which produce the weld without any further effort or skill on his part. The welder starts the arc by first touching the electrode to the work and then withdrawing it, thereafter maintaining a constant arc length by feeding the electrode wire to the weld at the exact rate of speed necessary to replace the electrode fused into the weld.

The automatic welding head incorporates the necessary mechanism for feeding the electrode to the arc, and consists essentially of a pair of feed rollers geared to a constant speed motor through a magnetic clutch. The

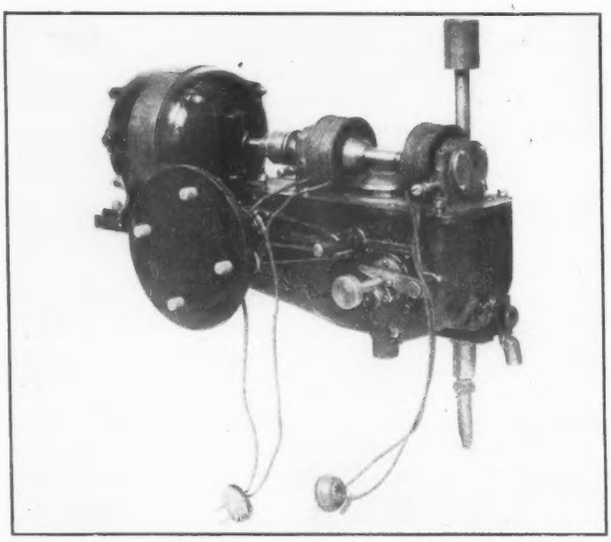


General Electric Type MC automatic welding head

gearing and feed mechanism are contained in one housing, to which the motor is bolted.

The rollers feed the welding wire through the nozzle to the arc. The distance and pressure between these rollers is readily adjustable. Each welding head is equipped with a set of nozzles for 3/32 in., ⅛ in., 5/32 in., 3/16 in., and ¼ in. wire.

The speed of wire feed may be adjusted by means of a selective gear changer, which permits the gear ratio to be altered at will to adapt the speed of the feed rollers to the size of wire and the welding current used. Three gear speed changes can be made by moving the gear shift pin which extends from the rear of the gear housing. An additional finer adjustment can be made by means of rheostat in the field of the motor. Provision is made for pointing the electrode backward or forward



Rear view of the General Electric automatic welding head

in the line of weld, and also for moving it sideways. The pointing of the electrode is obtained by rotating the head on its horizontal shaft, and the lateral movement by means of the handwheel on the front of the head.

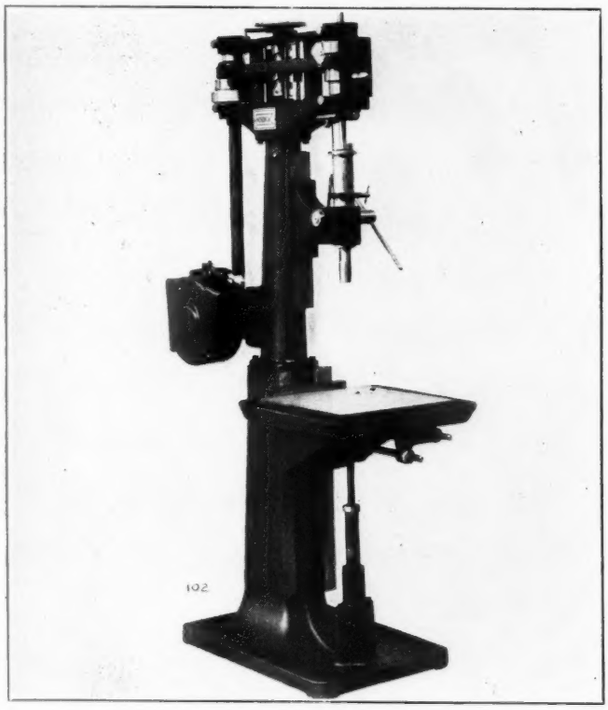
The control equipment consists of a control panel, a meter panel and a push-button station. The control panel mounts the main line contactor for the welding circuit and two smaller contactors for interlocking the travel motor with the arc. By means of auxiliary contacts the line contactor controls the starting and stopping of the feed motor. The magnetic clutch is operated forward or backward by a voltage relay, the coil of which is connected across the arc. Thus the electrode is fed to or from the work automatically, adjusting itself to any irregularities in the surface of the work. One rheostat

controls the speed of the feed motor and the other controls the voltage setting of the arc.

The new automatic arc welder is obtainable either separately (where the user constructs his own clamps) or as part of a complete welding equipment, including necessary clamps and framework for holding the work.

High speed ball bearing sensitive drills

THE accompanying illustration shows the No. 4 high speed ball bearing sensitive drill which, with the No. 3, has been added to the line of drilling machinery manufactured by the Fosdick Machine Tool Company, Cincinnati, Ohio. These machines are built in the single and multiple spindle types, with or without power feed, motor drive, pump and fittings and tapping attachments.



Fosdick No. 4 single spindle sensitive drill

The No. 3 bench-type machine is built with one to four spindles, while the No. 4 pedestal-type can be supplied with one to six spindles. Both machines are built in 16 and 24-in. sizes and have a capacity of ¾ in. drilling and ¼ in. tapping. All revolving parts are equipped with standard ball bearings protected with dust proof metal oil retainers.

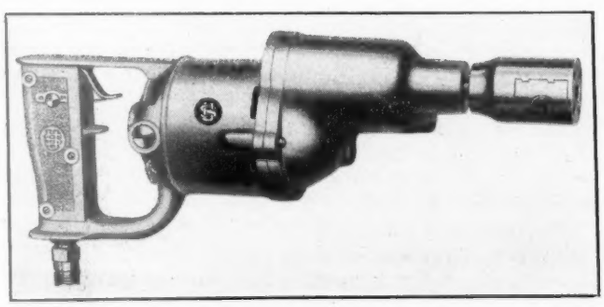
The belt-driven machines are furnished with a tight and loose pulley and swiveling belt guard and shifter. The drive is through spiral gears running in oil. The shifting of the belt on the four step cone is accomplished by means of a central cam drum so that the belt is shifted from one step of the cone before it is advanced to the other cone. Before shifting the belt the tension is taken from the belt automatically by the operation of the idler cam, which releases the tension on the idler. The adjustable spindle collar mounted on the spindle sleeve can be set to disengage the feed at any desired depth of hole drilled.

The tables have a liberal oil channel for chips and lubricant. The No. 4 pedestal-type table is adjustable on the pedestal by means of telescopic screws and can be elevated or lowered and securely clamped with a lever in front of the table. The head is adjustable on the column and can be rigidly clamped in position. The spindle is of high grade spindle steel. The spindle sleeve is of steel and the entire design is built to meet the requirements for rapid and accurate production in accordance with the latest drilling practice.

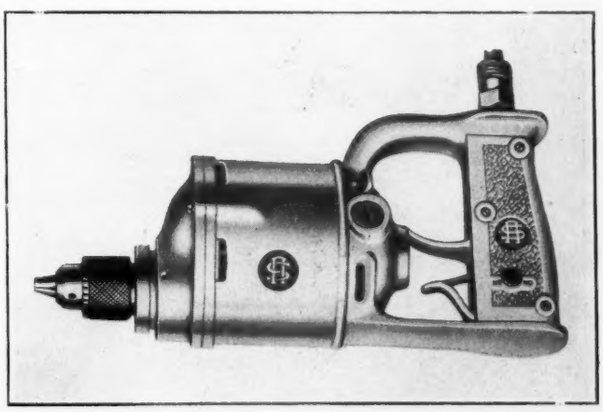
These machines are built under patents.

Portable tapper and heavy duty drill

THE United States Electrical Tool Company, 2488-96 West Sixty street, Cincinnati, Ohio, has recently placed on the market a portable tapper and a ¼-in. heavy duty drill. The portable tapper which is made in two sizes, No. 1 and No. 2, operates on direct and alternating current. The mechanism in this tapper is so designed that the chuck automatically reverses when the operator gives a backward pull on the tapper. When tapping, this clutch has a



The chuck of this portable tapper automatically reverses when the operator gives a backward pull on the unit



A ¼-in. heavy duty electric drill which has a load speed of 1,500 r.p.m.

positive engagement. When extracting the tap the engagement is by a friction clutch. This feature helps to eliminate tap breakage.

The ¼-in. heavy duty drill is equipped with four S.K.F. ball bearings, all of which are mounted in steel castings. The bearings are placed in the front and back of the spindle, in the handle and in the in and out thrust. A 1,500 r.p.m. motor is used.

Westinghouse box type electric furnace

A NEW box or hearth type electric furnace particularly applicable to the tempering of lathe and planer tools, dies and punches in tool rooms is now being manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

The furnace is constructed of a shell of heavy boiler plate, riveted and bolted to a structural steel frame, and heavy front castings. The heat insulations and the heating chamber are enclosed in the shell. The entire roof is assembled in a frame and bolted to the lower portion of the shell. A feature of this construction is that the roof may be lifted and swung to one side for the inspection or repair of the linings and the heating elements.

The direct radiating heating elements, made of nickel-chromium are protected and open, and are assembled in a frame of the same metal. They may easily be removed if necessary. A cast nickel-chromium floor-plate distributes the heat evenly, protects the bottom element, and forms a smooth surface for handling the material in and out of the chamber.

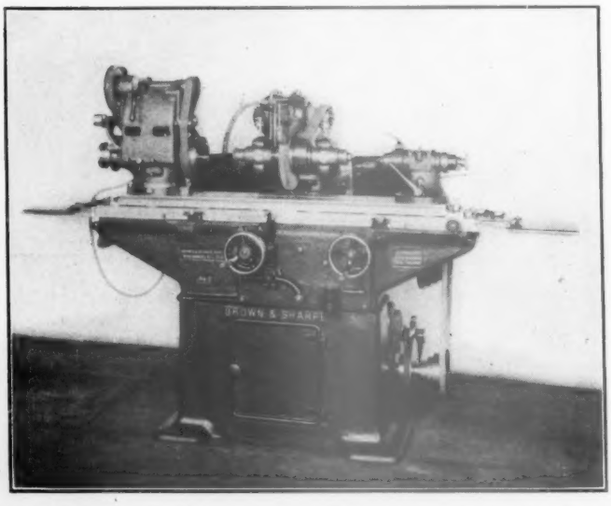
Automatic regulation controls the furnaces within very close temperature limits, which can be fixed as desired up to the limit of 1850 deg. F. This permits economy of operation by eliminating improperly heated charges, and by reducing the operator's time in attending the furnace.

Three sizes are built having capacities, at 1500 deg. F., of 100, 240 and 360 lb. of steel per hour, and with connected loads of 15, 27 and 40 kw. respectively. The smallest size uses single phase, 110-volt current; the middle size, single phase, and the largest size, 1, 2 or 3-phase, 220-colt current.

One of three sizes of the Type H electric furnace

Motor drive for Universal grinding machines

BY MEANS of motor drive, the Nos. 2, 3 and 4 Universal grinding machines manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I., have become completely self-contained and independent units, requiring no more floor space than the same machines when belt-driven from the main line.



The Brown & Sharpe No. 2 Universal grinding machine equipped with three motors

Power for the headstock drive, for the wheel spindle drive and for the table feed drive on each machine, is supplied separately by three individual electric motors. The three motors are controlled by a single push button switch, located at the front of the machine near the controls and within immediate reach of the operator. "Burning out" of the motors through overloading is prevented by means of protective plugs located in the magnetic switch control box, which is mounted on the base casting at the rear of the machine. Any motor not needed may be cut out by removing one of these protective plugs from this switch.

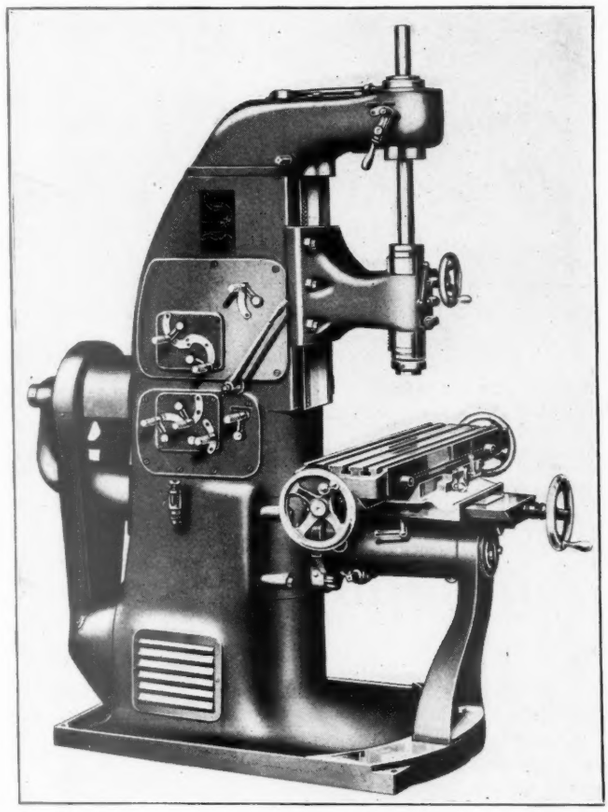
The motors are amply protected, yet readily accessible and in advantageous positions for the efficient delivery of power to the operating parts. The work driving motor is mounted on the headstock which is compactly designed and has provision for driving the work on either live or dead centers by means of an arrangement of belts, pulleys, idlers and belt tighteners. The wheel spindle driving motor is firmly mounted on the wheel stand, and is bolted to the wheel stand platen. The drive is direct from the motor pulley to the spindle pulley, except when the in-

ternal grinding attachment is used. In this case the spindle is replaced by a countershaft through which the drive is taken to the attachment mounted on the platen, which has been placed in the reverse position. The motor for providing power for the automatic table travel and cross feed is located at the rear of the machine. This motor also drives the pump, which provides an abundant supply of water for wet grinding.

Several types of constant speed motors and various types of control equipment suitable for use with direct or alternating currents are offered to meet various installation requirements.

Milling and drilling machine for many operations

MILLING, drilling, boring, shaping and similar operations may be performed with the No. 4 miller now being placed on the market by the W. B. Knight Machinery Company, 3920 Pine street,



The Knight No. 4 miller, designed for milling, drilling and boring

St. Louis, Mo. Because of its versatility, several operations can often be carried out with one chucking of the work that would ordinarily require a number of machines and set-ups. This machine differs in several respects from former models built by this company. For instance, the machine is of unit construction with a closed column and with one casting replacing several castings used in previous models. Instead of a countershaft drive, the machine is driven by means of a Johnson friction clutch.

Another improvement is that the knee has a direct bearing on the base of the machine, instead of on the lower end of the column. Also, the table is tilted by means of a worm mechanism instead of by hand. All the gears and clutches are made of heat-treated alloy steel and force-feed lubrication is provided to all gears and bearings within the column. The drive is through a silent chain from a built-in motor in the base. Cutters are held by means of a special adapter collet instead of by a draw-bar. The spindle nose is arranged for imparting a positive drive to the cutters.

The combined column and base casting is heavily ribbed and has large bearing surfaces for other parts. The table unit is arranged to swivel around the column, which considerably increases the range of the machine. The projecting arm on which the knee, saddle, and table are mounted, not only has a large bearing on the column, but is also rigidly supported at the outer end. The knee, saddle and table unit may be tilted around the projecting arm 45 deg. from the horizontal on either side. The degree to which it is tilted is indicated by a graduated segment. When the table is in the horizontal position, a taper pin is placed through the knee and the projecting arm to insure rigidity and alinement.

The spindle head may be raised and lowered by means of a screw, and locked solidly in the desired position. This gives the advantage of a fixed-head construction and also increases the capacity of the machine. The spindle runs in solid bronze bearings, the lower one being 12 in. long and tapered to provide means of compensating for wear.

Both feed and speed changes are accomplished through sliding gear transmissions, so designed that all gears not in use are locked in neutral. The spindle speed gears are assembled in one unit, which is mounted on the left-hand side of the machine, while the feed gears are located in another unit placed directly beneath. The power feed to the spindle is reversible and stops are provided to prevent over-travel of the spindle. The table may be locked for boring operations.

Three hardened and ground steel posts known as "precision locators" may be specially fitted to the machine. These posts adapt the machine for jig boring and similar work requiring accurate spacing and machining of holes. With these posts and the use of a micrometer, vernier or gage-blocks, the operator can quickly and accurately lay out one hole from another.

Whipp open side shaper planer

A REDESIGNED open-side shaper planer which has a more rigid construction than the previous machines and convenient control features has recently been developed by the Whipp Machine Tool Company, Sidney, Ohio. This machine is adapted to the planing of valve motion links and rod brasses.

The base of the new machine is heavy and it has cross ties from wall to wall. A corner brace has also been added between the pad for the column and the adjacent side. The column is a hollow tube with 1-in. walls, internally ribbed and is secured to the base with a large key and six 1-in. bolts. The cross rail is of ap-

proximately box section, is heavy and is arranged to hook around the column in a manner intended to develop its full strength. The saddle and its parts are heavy and in strength are proportional to other parts of the machine.

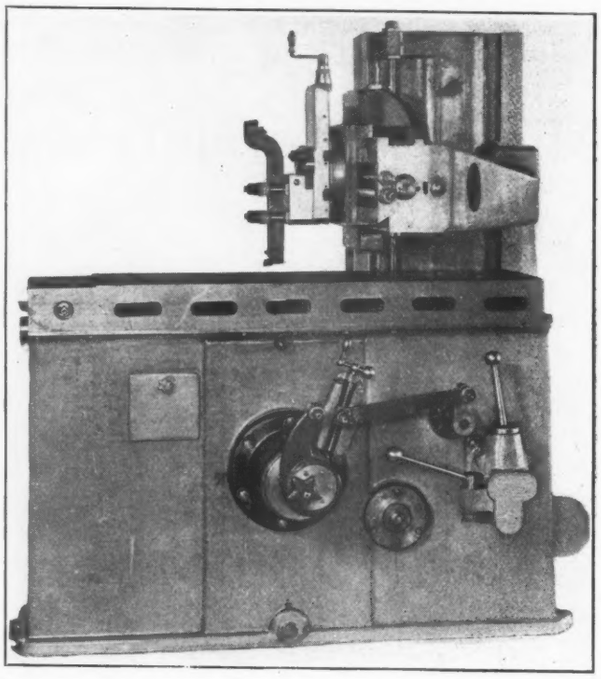
The bull gear is a steel forging and is shrunk, bolted and pinned to the semi-steel center. It weighs 480 lb. This gear has helical teeth of coarse pitch. The gear box is arranged as a unit which may be removed conveniently for inspection. It is oil tight and lubricated separately from other units of the machine.

The table is of box section with twice the depth of the table on the former machines, and it is somewhat heavier. The clutch is of the dry-plate type and is said to be powerful enough to start and stop the machine in the middle of the heaviest cut it can take. A brake is provided with the clutch to stop the table quickly. The vise is of the single-screw swivel-base type and weighs 380 lb.

The gear shift and the start and stop lever are contained in one unit. The feed is adjustable while the machine is running. All controls, adjustments and clamps are arranged so that they may be reached conveniently from the operator's position.

The drive of the machine may be by motor and silent chain or by single-pulley from a line shaft. For the motor drive a 7½-hp. or 10-hp. 1,150-r.p.m. motor is recommended, the smaller motor being for the 26-in. machine and the larger motor for the 36-in. machine. The motor is mounted on a bracket and off the floor and is suitably guarded. Push button control can be had.

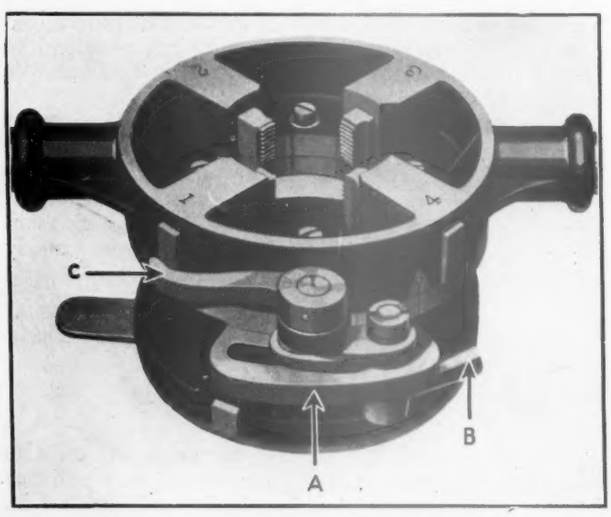
The table travel of the 36-in. machine is 36½ in. The maximum distance under the cross rail is 18 in. The total cross feed is 25 in., down feed, 9 in., and the maximum, horizontal and vertical feed is ⅜ in. and ¼ in., respectively. The table is 62¾ in. long and 17½ in. thick. The height of the table from the floor is 43½ in. Six strokes, ranging from 5.5 to 43 per min. are provided for the table. The net weight of the machine is approximately 7,200 lb.



An open side planer suitable for finishing rod brasses, valve links, etc.

Beaver die stock with an adjustable cam

THE feature of the No. 70 series Beaver adjustable die stocks, manufactured by the Borden Company, Warren, Ohio, is that the die adjusting cam is underneath the dies. By this arrangement all obstruction above and around the threading dies is eliminated and the full width of the dies is openly exposed above the body of the tool for the free application of oil. In addition, there is a solid wall opposite, or back of the throats of the dies, which reduces the tendency of dies to tip when pressed against the pipe, and causes them to take hold and start more easily.



The die adjusting cam of the Beaver No. 70 series die stocks, is underneath the dies

The open construction causes chips to fall out and away from the dies instead of to accumulate within the stock. There is free chip clearance around the larger size pipe taken by each tool, as well as around the smaller sizes.

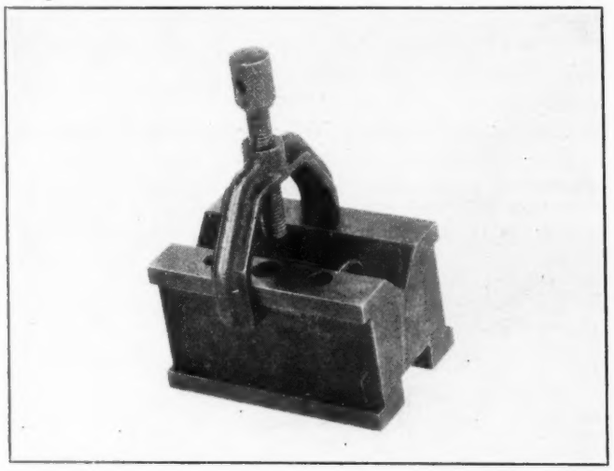
The construction consists of two main parts, a die head and a body casting, between which lies the die cam. Referring to the illustration, *A* is a projecting section of the die cam which is a part of the locking device and also serves as an adjusting handle. The lever *B* clamps the die cam (section *A*) firmly, but, as an added means to insure against slipping, section *A* is tapered and any tendency of the locking device to slip under the strain of threading is more than overcome. Thus the lock is positive, yet quickly and easily adjusted. *C* is a lever with a crank action. Turning this lever to the left opens the dies sufficiently to clear the pipe and saves time and possibly injury to the dies, when backing off over the finished thread; turning it back closes the dies to duplicate exactly the previously cut thread. This is desirable in production work.

Provision is made for the quick changing of dies, without removing any parts and without the aid of tools.

A three-jaw Universal chuck quickly and accurately centers all sizes of pipe within the range of the tool. No locking is necessary.

B. & S. handy block and clamp

AN accurately machined and carefully case-hardened steel block with a substantial clamp and screw designed for general usefulness in the garage and shop, has been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I. It is especially useful in holding small circular or flat pieces while being milled, ground or drilled. Bent rods and

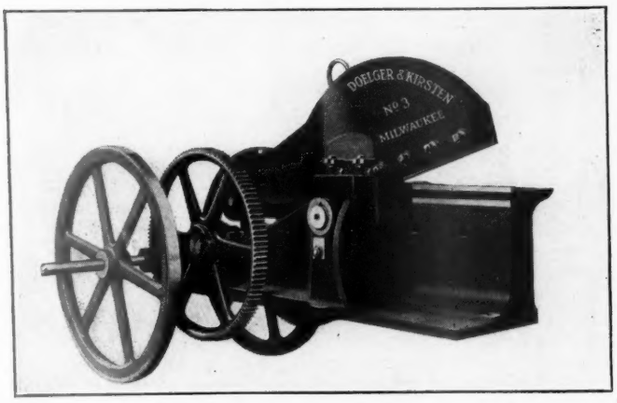


The Brown & Sharpe handy block and clamp can be used for many purposes

flat stock can be quickly straightened with the block, and small pieces, too small for the bench vise, can be filed or center-punched with ease. It is 3 in. long, 1¾ in. high and 2 in. wide. It is capable of holding round stock up to 1 in. in diameter and flat stock up to ¾ in. by 1¼ in.

Milwaukee No. 3 all-steel shears

THE Milwaukee No. 3 high knife shear with 36-in. blades, manufactured by Doelger & Kirsten, 3015 Chambers street, Milwaukee, Wis., has been designed to



High knife shear with a capacity of 4-in. round and 3¾-in. square material

shear long sheets, car sides, etc. The jaw, base, gears and pinions are made of annealed steel castings. Owing to the fact that the fly wheels and pulley are subjected to no strain, they are made of cast iron. The shear has double gears and double balanced fly wheels. It is made in the following sizes:

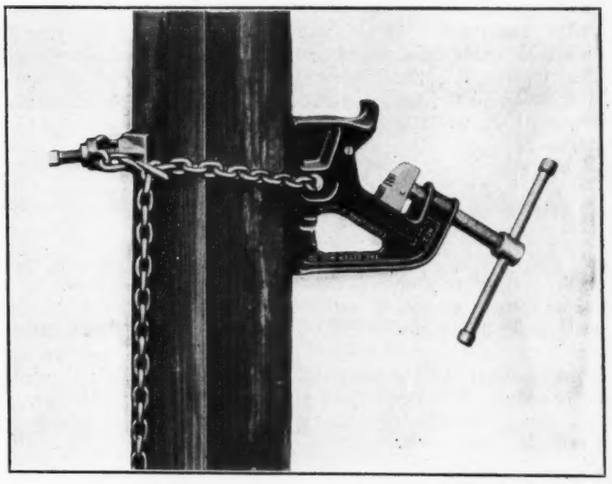
Style number	Capacity	Size of motor	Stationary or portable	Type of knife
1	1½ in. round or square	3 hp.	Both	Low
1½	2 in. round or square..	5 hp.	Both	High
2	3 in. round or 2¾ in. square	7½ hp.	Stationary or on timbers	Low or high
3	4 in. round or 3¾ in. square	15 hp.	Stationary	Low or high
4	5 in. round or 4¾ in. square	35 hp.	Stationary	Low or high
5	7 in. round or square.	75 hp.	Stationary	Low or high

These machines can be furnished either for motor or belt drive. Any of the above sizes can be furnished in the automatic style; that is, fitted with clutches and automatic stop attachments.

Quick acting inclined side-opening pipe vise

THE Oster Manufacturing Company, Cleveland, Ohio, has recently placed on the market an inclined, side-opening pipe vise which grips and releases the pipe with one turn of the handle and is said to require less than half the time of the old type hinged vise. It is equipped with oil tempered, tool steel jaws so designed that they will grip the pipe securely without the danger of squeezing it out of round.

A special chain and clamp for fastening the vise to a



The Oster quick-acting pipe vise may be quickly clamped to a post

post are furnished for use where it is not possible to bolt the vise to a work bench. Another useful accessory is a special eye bolt for pipe bending.

The vise will handle pipe from ⅛-in. to 2½ in. in diameter. The jaws will open wide enough to accommodate a 2-in. coupling, so that short nipples can be handled.

AUTOMATIC ARC WELDING.—The principles of "Stable-Arc" automatic welding are diagrammatically illustrated in the 24-page bulletin on welding equipment published by the Lincoln Electric Company, Cleveland, Ohio. The carbon electrode process is used with the "Stable-Arc" equipment, a filler rod of mild steel being placed along the seam prior to welding to supply additional metal to reinforce the weld. The time required to make different types of welds on metal of various gages is given in tabular form.

News of the Month

PROMOTIONS AND APPOINTMENTS · I.C.C. · THE SUPPLY TRADE · CLUB AND ASSOCIATION NEWS · NEW TRADE PUBLICATIONS · NEW SHOPS

First Lieutenant C. F. Parsons, Engineers Reserve, general master mechanic, New York Central, with headquarters at Albany, N. Y., has been promoted to captain, engineers reserve, and is assigned to the 489th Railway Engineers Battalion.

Captain J. G. Hilgen, Engineers Reserve, storekeeper, Chesapeake & Ohio, with headquarters at Richmond, Va., has been assigned to the 568th Railway Engineers Battalion.

NEW YORK, NEW HAVEN & HARTFORD.—A contract has been awarded to the J. N. Leonard Company, New Haven, Conn., for alterations to and extension of the car repair shop at the Lamberton street yard, New Haven, Conn., estimated to cost $125,000. This company has also authorized the construction of an addition to the boiler room at Norwood Central, Mass., estimated to cost $27,800.

Frisco reduces hot boxes

The St. Louis-San Francisco established a record on the system in September, 1926, when it made 78,212 car miles per hot box as compared with 17,619 car miles per hot box in September, 1921. The number of hot boxes in September of this year totalled 422 on freight trains and 5 on passenger trains, while in September, 1921, there were 1,200 on both classes of trains. The trains on the system made 33,396,683 car miles during September, 1926, while in September, 1921, they made 21,142,511 car miles.

Advances in wages

The Delaware, Lackawanna & Western, the Lehigh Valley and the Reading have granted increases of pay of two and three cents an hour, to shopmen, carmen, car cleaners and laborers.

The St. Louis Southwestern has granted an increase of 2 cents an hour for mechanics, 1½ cents for intermediate workers, and 1 cent for apprentices and helpers, following a conference between officers of the road and representatives of the Carmen's Association. The increase affects about 400 men. Members of the locomotive department have presented a petition asking for a raise in their group.

Coal in August $2 57

Class I railroads paid an average of $2.57 per ton in August for coal used as fuel for road locomotives charged to operating expenses, according to the Interstate Commerce Commission's monthly compilation of railroad fuel statistics. This compares with $2.65 for August last year. The average cost of fuel oil was 2.95 cents per gallon, as compared with 3.23 cents in August last year. The total cost of coal and oil for the month was $25,272,177, as compared with $26,198,605 in August, 1925. For the eight months ended with August the railroads expended $209,784,721 for fuel for road locomotives, as compared with $213,926,911 for the corresponding period of last year.

Wage statistics for August

The number of employees reported by Class I railroads to the Interstate Commerce Commission as of the middle of the month of August was 1,853,070, a decrease of 4,149 as compared with the number for July. As compared with August, 1925, there was an increase of 52,851. The total compensation for the month was $256,761,368, as compared with $247,071,210 in August, 1925. The report for August includes a chart comparing the trends of the average compensation per employee per hour and the labor expense chargeable to operating expenses per 100 equated ton-miles, from 1916 to 1925. The labor expenses per 100 equated ton-miles is given as follows (in cents): 1916, 27.3; 1917, 29.5; 1918, 42.9; 1919, 49.5; 1920, 58.3; 1921, 57.2; 1922, 51.6; 1923, 48.8; 1924, 49, and 1925, 47.2.

Interchangeability of Miller and G.R.S. train stop

Recent tests made by the New York Central on the high speed tracks east of Cleveland have shown that engines carrying receivers of the Miller alternating current type train stop also function correctly with the inductors of the General Railway Signal Company's auto-manual type. These demonstrations included tests up to full speed for passenger trains through air gaps up to 2½ in. with a lateral offset of 5 in. and another test with an air gap of 3½ in. with a lateral offset of 3 in. The receivers in these cases were 5 in. and 6 in. above the rail level. A test was also made with an air gap of 1½ in. and a lateral offset of as much as 6½ in. The Miller receivers and inductors operate through 6 in. air gaps and comparable lateral offsets. Engines equipped with the Miller apparatus may, therefore, be operated over the Miller type of rail-level integrity-checking inductors on new installations without replacing the present auto-manual inductors now in service on previous adjacent installations on railroads.

Locomotives and freight cars installed

Locomotives installed by the Class I railroads in the first nine months this year totaled 1,664, the Car Service Division of the American Railway Association has announced; an increase of 322 over the corresponding period last year. Locomotives on order on October 1 this year totaled 443, compared with 237. Freight cars installed in service in the first nine months totaled 85,383, a decrease of 28,432, under the number for corresponding period in 1925, and 35,344 under the corresponding period in 1924. This included 8,158 installed during the month of September, of which 3,646 were box cars, 3,313 coal cars and 468 refrigerator cars. Class I railroads on October 1 had 16,846 freight cars on order compared with 21,055 on the same date last year and 49,702 on the same date in 1924. These figures as to freight cars and locomotives include new and leased equipment.

The Lehigh Legion of Honor

This is the name of an honor roll which E. E. Loomis, president of the Lehigh Valley proposes, as a means of giving recognition to the efforts of employees who, by suggestion or invention, contribute to the efficiency of operation of any or all departments of the railroad; action to be based on the decision of a board of officers. President Loomis, explaining the proposition in a circular, says:

"The management values the loyal co-operation of its people and the Lehigh Legion of Honor is intended to give substantial expression of its appreciation of the efforts of employees to do more than what might regularly be expected of them. Nomination for legion membership should be submitted to the president, through regular channels, endorsed by the heads of the proper departments and accompanied by a full explanation of the reasons upon which the nomination is based.

"A certificate of membership and a suitable decoration will be awarded to those selected for the honor. Legion men will be entitled to special consideration in making promotions. Tests are

to be applied to nominees for legion honors by officers of the company, who, themselves, are not eligible for membership; and only those who made a distinct contribution to the success of the company will receive the award."

Special studies for Pullman shopmen

The Pullman Car & Manufacturing Corporation, during the winter months, is giving a course of training in production methods to approximately 1,000 employees in both the Pullman (Ill.) and Michigan City (Ind.) plants. The course is specifically and definitely a car building course based largely upon the experience of the executives of both plants and consists of six units: (1) team leadership; (2) handling men; (3) handling equipment; (4) organization; (5) plant records; and (6) management. Each unit can be read easily in a few hours and is accompanied by a shop problem. Each unit is used as a basis for departmental meetings in which principles are applied directly to each man's work. In addition, a lecture is given in which the principles can be clarified and application to special problems brought out. A general meeting will be held at four-week intervals and these will be supplemented by four smaller meetings. Departmental meetings are held one week before the general meetings.

Pullman employees instructed in first aid

Nearly 600 Pullman Company employees have either received Red Cross certificates for graduation in the first aid course or are now in training. The purpose of the course, which was inaugurated several weeks ago, is to teach men to think in terms of physical suffering, to cause them to view unusual situations in terms of safety, to create a tendency to put one's self mentally in the victim's position and to induce the pupil to study how to keep himself from being involved in an accident; to impel a man to analyze his particular job, and to urge men to take more interest in their physical well-being. A class of 25 safety supervisors, yard men and porters were first given a special course in Chicago, and these men later organized classes in New York, Chicago, Washington, Buffalo and San Francisco.

The course requires 15 hours' time from each pupil; or 1½ hours a week for 10 weeks. The Pullman Company furnishes instructors, material, text-books, etc., free. Technicalities are eliminated and fundamentals only are taught, such as shock, hemorrhage, artificial respiration, mobilization of fractures and the proper ways to lift and carry injured persons.

According to present plans some 600 additional employees will begin a 10 weeks' course after the Christmas holidays.

Meetings and Conventions

Mechanical Division, A. R. A., to meet in Montreal in 1927

The general committee of the Mechanical Division of the American Railway Association at a meeting held in New York on November 18, decided to hold the 1927 annual meeting at the Windsor Hotel, Montreal, Que., on June 7, 8 and 9 with no exhibits of railway appliances or machinery. This decision was reached as a result of an invitation from the executives of the two large Canadian railway systems, which are members of the Association and whose officers have been members of its predecessors since 1867. During the history of these organizations no convention of any of them has previously been held in Canada. The meeting in Montreal next year will coincide with the induction of G. E. Smart, chief of car equipment of the Canadian National, now vice-chairman of the division, into the office of chairman, to which he will succeed in the ordinary course of events at the next meeting of the division.

A. G. Trumbull, chief mechanical engineer of the Erie, was elected a member of the general committee to serve for the unexpired term of W. H. Fetner, deceasd.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, acting secretary, 165 Broadway, N. Y. Next meeting May 24, 25, 26 and 27, Mayflower Hotel, Washington, D. C.

AMERICAN RAILROAD MASTER TINNER'S COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 7, 8 and 9, Hotel Windsor, Montreal.

DIVISION V—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention Chicago, Sept. 7-9, 1927.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York. Annual meeting December 6 to 9.

AMERICAN SOCIETY FOR STEEL TREATMENT.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. Building.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Next meeting December 13. Paper on reclamation and conservation of material will be read by F. A. Starr, supervisor reclamation, Chesapeake & Ohio.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August, Hotel Statler, Buffalo, N. Y. Next meeting, December 9. Paper on terminal improvements at Buffalo will be read by W. F. Jordan, engineering assistant to the president, New York Central.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt railway, Clearing Station, Chicago. Annual convention, Chicago, September, 1927.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 811 Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting December 6. Paper on the progress and possibilities in safety will be read by T. H. Carrow, supervisor of safety, Pennsylvania, and chairman, Safety Section, American Railway Association.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Lafayette, Buffalo, N. Y., August 16-18, 1927.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant Railway Exchange, 80 E. Jackson boulevard, Chicago. Annual convention May 10 to 13, 1927, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Chicago, September 6-9, 1927.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt, St., New York. Annual meeting Chicago, May, 1927.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting December 14. Paper on automatic train control will be read by G. E. Ellis, secretary, American Railway Assn.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting, December 17. Annual dinner.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting December 9. History of the Santa Fe railroad will be presented by Lacy L. Galbraith.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting December 10. Paper on the start of the second century of modern transportation will be read by Col. Albert T. Perkins, manager for the receiver, United Railways of St. Louis. Christmas entertainment.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—C. Kimball, Inman shops, Southern, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1927.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

Allen, Sproull & Allen, Fort Worth, Tex., will in the future represent the Bridgeport Company in the southwest.

The O'Malley-Beare Valve Corporation has opened a city sales office at 217 Railway Exchange building, Chicago.

The American Machinery & Equipment Company, Detroit, Mich., has moved its offices to 2532 Twenty-fourth street.

John Parker has been appointed New England representative of the Rollway Bearing Company, Inc., Syracuse, N. Y.

The Roto Company has removed its headquarters from Hartford, Conn., to Sussex avenue and Newark street, Newark, N. J.

The Lincoln Steel Company, Chicago, has moved its offices from 2320 West Fifty-eighth street to 229 West Illinois street.

Charles Elliott, general superintendent of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., died on October 26.

Patrick W. O'Brien, assistant general manager of sales of the Illinois Steel Company, died in Chicago on November 9 of pneumonia.

The Ohio Brass Company, Mansfield, Ohio, is constructing a five-story steel and brick office building, 52 ft. by 255 ft., to cost $500,000.

Mefford R. Runyon has been appointed district sales manager for the New York Metropolitan district of the Bridgeport Brass Company, Bridgeport, Conn.

James D. Robertson, president of the Warren Tool and Forge Company, Warren, Ohio, died on October 28 at Pittsburgh, Pa., following a stroke of apoplexy.

Frederick G. Lewis, vice-president and director of George B. Carpenter & Company, Chicago, died on October 29 at Wheaton, Ill., following a short illness.

Bruce Owens, who has been elected vice-president of the O'Malley Beare Valve Corporation, Chicago, as was announced in the October *Railway Mechanical Engineer*, was born in Maysville, Ky., on March 12, 1883. In 1901 he entered the employ of the J. W. Barrett Brass Foundry Company at St. Louis, Mo. This company was later taken over by the Hewitt Manufacturing Company, which later became a part of the Magnus Company, Inc. In 1910 he was appointed service engineer of the latter company and in 1917 was promoted to assistant to the vice-president. He held the latter position until February, 1922, when he was promoted to sales manager.

Bruce Owens

Walter F. Brumm, assistant district sales manager of the Inland Steel Company, with headquarters at Kansas City, Mo., has been transferred to St. Louis.

The Cleveland Punch & Shear Works Company, Cleveland, Ohio, has removed its Philadelphia, Pa., office from 321 Bulletin building to 1201 Pennsylvania building.

The Pyle-National Company, Chicago, has awarded a general contract to C. Rasmussen for the construction of a one-story foundry addition, 25 ft. by 160 ft., to cost $50,000, with equipment.

The Cleveland offices of the Central Alloy Steel Corporation and the United Alloy Steel Corporation have been combined and moved to 1716 Union Trust building.

The Pollak Steel Company, Cincinnati, Ohio, has opened a sales office at Detroit, Mich., in charge of B. G. Lalman, sales engineer, and W. R. Klinkicht, metallurgist.

Henry N. Winner, general manager of the Garlock Packing Company, Palmyra, N. Y., died suddenly on November 12 at Philadelphia, Pa., while on a vacation, at the age of 47.

Henry Donovan has resigned as general manager of the manufacturing department of the General American Car Company, Chicago, and the position of general manager has been abolished.

John H. Rodger, vice-president in charge of the Chicago office of the Safety Car Heating & Lighting Company, has been promoted to vice-president in charge of railway sales, with headquarters at New York. George H. Scott, representative at Chicago, has been promoted to manager of the Chicago office and Carl A. Pinyerd, for the past few years district engineer in the Chicago office, has been promoted to commercial engineer with the same headquarters. John H. Rodger began work in 1899 with the Standard Coupler Company, New York, leaving that service in 1905 to become assistant to the president of the Monarch Machine Company. He was then for a time engaged in other business and returned to the railway supply business in April, 1911, when he entered the service of the Safety Car Heating & Lighting Company, and was assigned to the Chicago office as a sales representative. Subsequently he served as acting vice-president and later as western manager until his appointment in June, 1922, as vice-president, with the same headquarters, which position he held until his recent promotion to vice-president in charge of railway sales, with headquarters at New York.

J. H. Rodger

Ernest Smith has been appointed sales engineer of the Allis-Chalmers Manufacturing Company at the office at Oruro, Bolivia, which is a sub-office of the district headquarters at Santiago, Chile.

J. E. M. Schultz, representative of the Sullivan Machinery Company, with headquarters at Nashville, Tenn., has been appointed manager of the office at Dallas, Texas, to succeed D. H. Huster, resigned.

G. G. Jones, manager of the Chicago office of the American Locomotive Company, has been appointed sales engineer and B. W. Parsons has been appointed sales representative at St. Paul, Minn., with office at 1010 Builders' Exchange.

The Whitman & Barnes Manufacturing Company, Akron, Ohio, and the Detroit Twist Drill Company, Detroit, Mich., have been consolidated under the name of Whitman Barnes-Detroit, Corporation, with headquarters at Akron.

E. F. O'Connor, airbrake foreman on the Southern, with headquarters at Birmingham, Ala., has resigned to become a representative in the southeastern territory for the Edna Brass Manufacturing Company, with headquarters at Richmond, Va.

The Positive Lock Washer Company, Newark, N. J., originator of Positive type lock washers has appointed the Lundie Engineering Corporation of New York and Chicago, as its exclusive railroad sales agents for the United States and Canada.

George W. Denyven has been appointed New England representative of the Tyler Tube & Pipe Company, Washington, Pa.

Mr. Denyven will have his headquarters at Boston, Mass. W. H. S. Bateman & Co., Philadelphia, Pa., have been appointed special representatives.

Norman C. Naylor, sales agent of the Railway Steel Spring Company, with headquarters in the Peoples Gas building, Chicago, has been appointed district sales manager of both the American Locomotive Company and the Railway Steel Spring Company, with headquarters in the McCormick building.

The Globe Railway Equipment Company, St. Louis, Mo., has placed a contract with the Larkin Engineering Company, St. Louis, for the construction of two concrete, brick and steel buildings at Veedersburg, Ind. One building will be one story, 60 ft. by 150 ft., and the other will be two stories, 60 ft. by 200 ft.

W. P. Steele, accessory sales manager of the American Locomotive Company, has resigned. Mr. Steele's career began in 1880 on the Boston & Maine. In 1901 he entered the employ of the Galena-Signal Oil Company, resigning in 1906 to become assistant to vice-president of the American Locomotive Company. In 1912, he was promoted to assistant to president; in 1917, Chicago representative, and in 1919, sales manager of Alco accessories.

James B. Sipe & Co., Pittsburgh, Pa., manufacturers of Japan oils and paints for railroads, recently placed a contract with the Austin Company, New York, for a two-story addition, 60 ft. by 180 ft., to their plant at Bridgeville, Pa. They have appointed the following district managers of the railroad and car department: A. W. Fields, 640 Equitable building, St. Louis, Mo.; G. W. Lindholm, 125 West Forty-sixth place, Chicago; John H. McCartney, 165 Broadway, New York City. D. B. Vail, who has represented the company for fifteen years, continues as manager of the railroad and car department.

Cincinnati Grinders, Incorporated, Cincinnati, Ohio, has been incorporated recently with an authorized capital of $1,500,000 common stock and has succeeded to the grinding machine business of the Heim Grinder Company, Danbury, Conn., and the Cincinnati Milling Machine Company, Cincinnati. The manufacture of the Heim centerless and the Cincinnati plain, universal and centerless grinders will be continued as heretofore, and early in 1927 will be united in a modern plant at Cincinnati. The new company has acquired the Triumph Electric plant at Oakley, Cincinnati, and will convert this property into a modern and well equipped grinding machine plant. The new plant is expected to be in operation early in 1927 and will commence operations with a force of several hundred men. P. O. Geier is president of the new company, George W. Binns, secretary, and F. M. Angevin, formerly of the Heim Grinder Company, treasurer. The directors include R. C. W. Harrison, formerly grinding machine engineer of Churchill Machine Tool Company, Manchester, England, and C. Booth, formerly works manager of Heim Grinder Company, and previously engineer of the Heald Machine Company.

Union Switch & Signal Company acquires right to use Miller train control

A joint agreement has been entered into between the General Railway Signal Company, the Union Switch & Signal Company and the Miller Train Control Corporation whereby the two signal companies acquire the right to manufacture and sell the Miller train control systems and train-stop devices in the United States, east of the Rocky mountains, and also in the Dominion of Canada.

The General company had previously obtained a license from the Miller company, it being stated that the Miller organization would remain intact and had reserved the Chicago & Eastern Illinois, the Elgin, Joliet & Eastern and the Toledo-Detroit division of the New York Central. The new agreement provides for the same conditions. It is understood that the Miller engineers will co-operate with the engineering departments of both signal companies. Since the agreement was first made with the General company, the Miller engineers have been working with the engineering department of that company in designing and perfecting plans for effecting interchangeability and standardization, and this work is now well in hand.

Trade Publications

McCROSKY TOOLS.—Price lists and specifications for the McCrosky line of reamers, quick change chucks and collets, engine lathes, etc., are contained in Catalogue No. 10 of the McCrosky Tool Corporation, Meadville, Pa.

VERTICAL SLIDE TOOL.—A vertical slide tool for boring an internal recess 1¾ in. long and 1/64 in. deep, is illustrated and described in a four-page folder being distributed by the Warner & Swasey Company, 7501 Carnegie avenue, Cleveland, Ohio.

MOTORIZED POWER.—A 12-page bulletin illustrating G-E motorized power (electric locomotives, electric tractors and trucks, cranes and handling equipment) in actual use, has been issued by the General Electric Company, Schenectady, N. Y.

RAILWAY APPLIANCES.—The Morton Manufacturing Company, 5105 West Lake street, Chicago, is preparing for distribution early in January a new catalogue covering all of the items included in the Acme line of railway appliances and industrial steel products.

LEAD BASE BABBITTING.—Folder No. 4474 describing the babbitting of bearings and explaining the use of the Westinghouse automatic electric babbitting pots, has been prepared by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

LO-HED HOISTS.—The American Engineering Company, Philadelphia, Pa., has prepared a 42-page catalogue descriptive of the Lo-Hed electric hoist. The wide range of lifting and handling conditions under which the hoist operates, is shown in numerous illustrations.

RIVETERS.—Hanna riveted cars and locomotives and steel bridges are illustrated in the 12-page booklet prepared by the Hanna Engineering Works, 1765 Elston avenue, Chicago. A brief description of the different types of Hanna riveter is also contained in the booklet.

UNIT HEATERS.—The various types and applications of Buffalo unit heaters are described in catalogue No. 466 issued by the Buffalo Forge Company, Buffalo, N. Y. These heaters are for use in warehouses, freight sheds, depots, machine shops, foundries and other industrial plants.

STANDARD TOOLS FOR SMALL TURRET LATHES.—Standard tools for small turret lathes of any make are described in an attractive catalogue, No. MH-2A, issued by the Gisholt Machine Company, Madison, Wis. The catalogue is both alphabetically and numerically indexed.

SILENT GEARS.—Publication GEA-482 of the General Electric Company, Schenectady, N. Y., describes Fabroil and Textolite silent gears designed to eliminate continuous loud noise and the vibrations and shocks transmitted to the driven machines by gear trains running at high speed.

CENTRIFUGAL PUMPS.—The Ingersoll-Rand Company, 11 Broadway, New York, is distributing the second edition of Form No. 7059 descriptive of the Cameron single-stage, double-suction, volute centrifugal pumps suitable for direct connection to alternating or direct current motor, steam turbine, gasoline engine, or for belt drive.

SUPERHEATED STEAM PYROMETERS.—The Model 496 pyrometer for superheater locomotives is described in the third edition of the instruction book on superheated steam pyrometers which has been prepared by the Superheater Company, 17 East Forty-second street, New York. Instructions for the installation, operation and maintenance of the pyrometer, and a convenient list of parts are given in the book.

GENERAL CATALOGUE.—The Ohio Brass Company, Mansfield, Ohio, is distributing catalogue No. 20, completely listing all O-B porcelain insulators, trolley and line materials, rail bonds, car equipment and mining materials. Signal bonds and other special products of interest to the signal departments of steam railroads are grouped in one section of the catalogue, and there is a comprehensive listing of automatic car couplers, including electric and air connections, suitable for electrified terminal zones.

Personal Mention

General

J. W. Womble, mechanical superintendent of the Midland Valley, with headquarters at Muskogee, Okla., has also been appointed mechanical superintendent of the Kansas, Oklahoma and Gulf.

F. F. McCarthy has been appointed district superintendent of motive power of the New York Central, with headquarters at Elkhart, Ind., with jurisdiction over the Fourth district, succeeding W. R. Lye.

N. J. Boughton, mechanical engineer of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been promoted to engineer of tests, with the same headquarters, succeeding C. L. Buckingham, deceased.

Master Mechanics and Road Foremen

C. G. Goff has been appointed master mechanic on the Southern, with headquarters at Birmingham, Ala.

L. C. Shults has been appointed master mechanic on the Southern, with headquarters at Atlanta, Ga.

O. Small has been appointed master mechanic on the Southern, with headquarters at Alexandria, Va., succeeding A. M. Lawhon.

W. H. Keller has been appointed master mechanic of the Louisiana & North West, with headquarters at Homer, La., succeeding J. T. Simpson, resigned.

William F. Buscher, general master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie at Minneapolis, Minn., was shot while in his office at Shoreham yards, Monday, November 22. The assailant had been discharged from his duties as a fireman last May, and had returned to Minneapolis seeking reinstatement. Being refused by Mr. Buscher, he fired three shots two of the bullets taking effect in Mr. Buscher's arm and thigh.

H. C. Trexler, shop superintendent of the Southern at Spencer, N. C., has been appointed master mechanic of the Ferguson shops at Somerset, Ky. Mr. Trexler was born on January 3, 1894, in Rowan County, N. C. He attended an academy at Salisbury, N. C., and on August 14, 1909, entered the service of the Southern as a machinist apprentice at Spencer. He finished his apprenticeship in December, 1913, and until May, 1919, was employed as a machinist. He was then promoted to foreman machine shop, and in April, 1920, promoted to foreman erecting shop. In June, 1924, he became shop superintendent at Spencer.

Car Department

P. J. Cummings, foreman car inspector of the Missouri Pacific, has been promoted to general car foreman, with headquarters at Alexandria, La.

Shop and Enginehouse

T. C. Carter, general foreman of the Illinois Central at Vicksburg, Miss., has been transferred to Monroe, La.

W. R. Bryan, roundhouse foreman of the Illinois Central at Monroe, La., has been transferred to Shreveport, La.

W. M. Kelley, locomotive inspector of the Illinois Central at Monroe, La., has been promoted to night roundhouse foreman.

G. E. Bell, machinist, has been promoted to day roundhouse foreman of the Illinois Central, with headquarters at Monroe, La.

Purchases and Stores

J. F. Newman, storekeeper of the Pennsylvania, with headquarters at Pitcairn, Pa., has been transferred to Pittsburgh, Pa., succeeding W. C. Livingston, who has been assigned to Mr. Newman's former place at Pitcairn.

R. F. Homer has been appointed acting assistant storekeeper on the Pennsylvania at Altoona, Pa., succeeding W. W. Shugarts.

W. W. Shugarts has been appointed storekeeper on the Pennsylvania at Altoona, Pa., succeeding H. R. Wood, relieved on account of illness.

C. B. Sauls, division storekeeper on the Illinois Central, with headquarters at McComb, Miss., has been appointed storekeeper of the Gulf & Ship Island in addition to his present jurisdiction.

J. C. Neph, assistant district storekeeper, on the Southern Pacific, at El Paso, Tex., has been promoted to general inspector of stores and supply train service, with headquarters at San Francisco, Cal., succeeding J. C. Neph.

Frederick I. Plechner, assistant purchasing agent on the Great Northern, at St. Paul, Minn., has been promoted to purchasing agent, with the same headquarters, succeeding Fred A. Bushnell, resigned. Mr. Plechner was born on February 8, 1871, at St. Paul. He graduated from the St. Paul High School in the class of 1889. Prior to entering railway service he was traveling representative in Oregon, Washington and Idaho for a wholesale and manufacturing firm, with headquarters at St. Paul. His connection with railroad work began on December 1, 1913, when he was appointed assistant purchasing agent on the Great Northern at St. Paul. Mr. Plechner now has jurisdiction over the entire purchasing and stores department of the Great Northern.

Frederick I. Plechner

Obituary

Howard M. Curry, formerly general mechanical superintendent of the Northern Pacific at St. Paul, Minn., died on November 23. Mr. Curry, until his retirement in 1923, had been an employee of the Northern Pacific for forty-three years. He was born on January 6, 1861, in Ogle County, Ill., and entered railway service in April, 1880, as a shop man and locomotive fireman on the Northern Pacific, being promoted to locomotive engineer in July, 1882. He was promoted to assistant road foreman of engines of the lines east of the Missouri river on December 1, 1891, and in December, 1898, was promoted to road foreman of engines. He became division master mechanic at Fargo, N. D., in November, 1901, and was transferred to Staples, Minn., in December of the following year. He was appointed general master mechanic of the lines east of Billings, Mont., in February, 1905, and in January, 1908, was given extended duties as general master mechanic to include the lines east of Paradise, Mont. In January, 1910, he became general master mechanic of the lines east of the Missouri river; in May, 1911, mechanical superintendent, and in August, 1920, general mechanical superintendent.

Howard M. Curry